THE
PEDAGOGICAL SEMINARY
Founded and Edited by G. STANLEY HALL
VOL. XXVII MARCH, 1920 No. 1

THE HYGIENE OF SLEEP

By WILLIAM H. BURNHAM

It is a remarkable thing that we know little about the most fundamental processes in our daily life,—activities vital and essential to our health and happiness. Particularly is this true of the phenomenon of sleep. All sorts of theories have prevailed in regard to it; some of them absurd; some of the recent ones extremely illuminating.

If we look at the whole matter objectively, as we might imagine a being doing in some other planet where sleep is unnecessary, if we take such an objective view, we may naturally ask, is this a stupid habit into which the human race has fallen, just as some animals indulge in a hibernal sleep from lack of stimulation, or is it an essential condition for health and normal activity? The answer to this question is simple, and has been given definitely and concretely, not only by the observation of the race, but by recent investigations that have shown poisonous products present in the nervous system under conditions of prolonged wakefulness.

If one should speak of a condition in which the temperature of the body is decreased, the pulse and respiration retarded, the eyeballs rolled upward, the pupils small, fatigue and relaxation of the muscles apparent, the eyelids heavy, consciousness obscured or lost as in narcosis,—then it would seem, as one writer has suggested, as if one were trying to describe a morbid condition, as appears in some cases of acute poisoning; and yet, it is a physiological condition; namely, sleep. The poet is not far wrong in calling sleep the image of death.

The poet, however, is apt to see only the superficial features of physiological processes, however acute may be his insight for the higher transcendental realities. The physiologists have hardly done much better.

All the theories of sleep reviewed by Foster(10) and Claparède,(8) with the exception of two or three dynamic hypotheses, have one thing in common, they regard sleep not as a function but rather as the cessation of the functioning of the organism, with the exception of nutrition. It is largely a negative, passive state. And Maudsley even treats the subject in his "Pathology of the Mind," not in his book on "Mental Physiology." Sleep, according to these old theories is a form of anaemia, a depression or compression of the brain, an asphyxia, an intoxication, or the like. This negative doctrine of sleep has been formulated by Bertin. "Sleep," he says, "is nothing unless it is the cessation of the special functioning of the brain . . . sleep is then a negative condition of the nervous system. It represents the cessation of the special activity of this mechanism" This idea is still prevalent in contemporary physiology.

As the most fundamental characteristic of the organism is response to stimulation, either internal or external, it would be strange if for a third of the life of the individual that fundamental characteristic were to be inhibited or abolished; and yet a large part of the theories of sleep represent it as a kind of negative condition, characterized by the cessation of function. What can be said from our present point of view for a different theory of sleep, that makes it not the cessation of function but an active function itself, a form of response to stimulation? Let us consider this subject from the point of view of stimulation and response, and determine if we can the normal stimuli on the one hand, and the normal response on the other. A theory that has become prominent in recent years is distinctly in harmony with this point of view, namely, the theory of Claparède,(8) according to which sleep is an instinctive reaction to certain stimuli.

This theory does not conflict with the facts upon which most other theories are based. Thus during sleep there is anaemia of the brain. There is apparently an accumulation of toxic products; there may be a diminution of the store of oxygen in the nerve cells; there may be shrinkage of the nuclei and a change in the character of the cell protoplasm, as found by Dr. Hodge in the case of animals as a result of the day's work. There may also be changes in the circulation of the blood, or inhibition of the nervous activity, or any one of a number of other physiological conditions; but all of these

are, according to Claparède, concomitants of the condition that we call sleep, not causes.

According to Claparède, sleep is a positive function of the nervous system. It is a means of protection, of defense. We do not sleep because we are exhausted, but we sleep to prevent being exhausted. We do not sleep because of auto-intoxication, but to prevent this. He cites the well known fact that sleep and fatigue are by no means parallel, but often fatigue prevents sleep. Many facts also indicate that sleep is similar to the instinctive reactions. In sleep we conform to the universal law of instinct, that of following the momentary, immediate interest; and the reaction of sleep may be produced like other instinctive actions either by external or internal stimuli.

To give Claparède's theory in his own words: "Sleep is not a purely negative, passive condition; it is not the result of a simple arrest of function; it is a positive function, an action of the reflex kind, an instinct, which has for its end this arrest of function. It is not because we are intoxicated or exhausted that we sleep, but we sleep in order not to become so."

As we see in the case of the different instincts, the essential thing is the reaction of the organism to stimuli. Now, if we take the case where the stimuli in a situation are monotonous as, for example, in a dark and quiet room, or where we listen to one sound, as the falling of water, the rhythmic action of monotonous music or the like, what is the form of reaction? Observation and experiment have shown that usually the reaction in such situations is sleep or some related condition, hypnosis, or the condition preliminary to hypnosis, called by some the hypnoidal state. In other words, sleep is a reaction of the nervous system to stimuli which impinge upon it, it is a positive reaction like any other instinctive reaction, but unique in its character.

The difficulty in accepting this view for the most part disappears when we remember that the stimuli which bring about instinctive reactions may be either internal or external. In the case of sleep both are active. The primary stimulus of sleep is the sensation of fatigue. The secondary stimuli are darkness, or light, the sight of familiar objects, monotonous sounds, and the like.

The reflexes, Claparède points out, the cardiac, the respiratory, the pupillar reflex of the eye, etc., are partial reactions of the organism. The mechanism of the reflex is rigid, prompt, inevitable, and usually outside of the control of the will. The mechanism of instinct, on the other hand, is more elastic, and modified more or less according to the surrounding circumstances. Instinct is an all round reaction, a true reaction of

the whole being, monopolizing all the motility and all the attention of the individual. It is reaction to the whole situation, and it can be instantaneously modified according to circumstance if it is for the interest of the animal to turn his activity suddenly in another direction. Thus it results, that at each moment it is an instinct, and naturally the instinct most adequate to actual circumstances, to the situation, which alone dominates the animal's activity. This is the one fundamental law of vital behavior, which deserves to be called law of the supremacy of the instinct momentarily most important, and which Claparède formulates as follows: "At each instant the organism acts along the line of its greatest interest."

The mechanism of sleep, according to Claparède, is as follows: many examples show that sleep only comes and only persists and is only complete in so far as the interest of the subject for external surroundings is less intense than the instinct of sleep; that is, sleep is opposed to interest in surrounding objects. It is a phenomenon of lack of interest in the external world. It is indifference to the present situation; it is a kind of psychological suicide. The being that sleeps renounces *ipso facto* perception of the external world and to a certain degree life; sleep is momentary abdication. Psychological analysis leads to a similar conclusion. Thus Bergson says, 'to sleep is to give up interest. One sleeps in the exact measure in which one gives up his interest.'

The law of momentary interest accounts for the plasticity of sleep. The instinct varies greatly in different individuals; but this is true of instinct in general; and especially with man instinct is modified by habit.

A number of facts seem to be explained more satisfactorily by considering sleep as an active instinctive reaction than in any other way, especially the following. Most of these have been mentioned by Claparède, some have not.

1. There is no direct parallelism between sleep and fatigue. Serious fatigue often makes sleep impossible, or if it occurs it is fitful, not deep and continued. One who is sleepy and rouses himself to continued activity often finds later when he tries to sleep that he cannot. Again, it has often been observed that if children or nervous patients take a nap in the afternoon they sleep all the better the following night.

2. The methods of going to sleep are instructive. Best of all is any device which inhibits the active play of interest. On the other hand, the effort to go to sleep is apt to defeat its own end, and fear of insomnia in pathological cases may be a serious cause of sleeplessness. The way to bring about an instinctive reaction is not to will it but to yield ourselves

to it. In the case in question, it is sometimes more effective to try to keep awake than it is to try to sleep. The stimuli to sleep are also well explained by this theory. They are many and varied. First of all are the sensations of fatigue. Among others, as everybody knows, are darkness, or, in the case of nocturnal animals, light; the sight or representation of the place where one is accustomed to sleep, a couch or bed or the like; a certain attitude, closure of the eyelids; the idea of sleep and the sight of other persons sleeping; the knowledge of the hour, the knowledge perhaps of a certain time for being awakened, etc.

3. The remarkable things many people can do in spite of being asleep. Many persons can go to sleep with full confidence of awakening whenever it is necessary, if the temperature of the room becomes too low or too high, if danger threatens, if a fire alarm should ring, if a neighbor calls for help, or the like.

"The individual,' says Sidis (20, p. 188), "may be asleep to all else and still be awake to special stimuli whose thresholds are very low. The mother watching over her babe, the nurse and the physician attending their patients, may be sound asleep to loud noises, but are alive and wide awake to the slightest changes in their charges. They have lost touch with the whole external world, but the ones cared for still have a firm hold on them. . . . Let an appreciable change occur in the stimuli to which we are awake, an amount of energy immediately is drawn from the reserve store, the thresholds barring the entrance to the host of intruders are lowered and we are once more in communication with the external world,—our sleep is gone and we are wide awake. *We can thus be wide awake in the very depth of our sleep.* The possibility of shaking off the grip of sleep under appropriate circumstances and especially the highly significant fact of wakefulness in the very depths of sleep form insuperable difficulties for all those plausible, apparently scientific theories of sleep, theories based on circulation, engorgement, anaemia or hyperaemia, narcosis and autointoxication. We can watch in our sleep, count the flow of time and awake at the right moment. The fact that we can sleep and still watch and keep awake in regard to special objects and particular persons shows that sleep is not a matter of blood circulation or of intoxication by accumulation of waste products in the system. Sleep is not a disease, not a pathological process due to the accumulation of toxic products in the brain or in the system generally. Sleep is not of those fatal uncontrollable onsets characteristic of the morbid processes, such as epilepsy, sunstroke, or apoplexy, nor is sleep a sort of narcolepsy."

4. Again the process of waking up has the characteristic of change from one instinctive activity to another. The stimuli which awaken us are excitations which interest us. We awaken at unusual sounds or the like, but do not mind habitual stimuli; just as when awake, if we are occupied with work a great number of sounds may strike our ears

without causing the least disturbance or the least reaction. The fact is, these noises interest us less than our work. It is the same when instead of being occupied with work we are occupied in sleep. With this difference, that sleep is much more absorbing than the most interesting kind of work.

5. A remarkable phenomenon is the power of many persons to awaken at a given hour determined upon when they go to sleep. This can be better explained by this theory than otherwise.

Tschisch and Vaschide(32) have made interesting experiments in regard to the condition of sleep when one attempts to waken at a definite hour fixed upon before going to sleep; and Tschisch found in his own case, from many tests made during three years, that he usually awakened before the time fixed upon, but not more than fifteen minutes before.

Vaschide used a questionnaire with some thirty-three subjects and supplemented the results of this by direct observations in two or three cases. His observers had rather a marked ability for waking at or near the time fixed upon; and he found a distinct difference between the sleep under such conditions and when no such attempt was made. The former he calls attentive sleep and the latter, normal sleep.

Vaschide, as the result of his interesting observations and experiments, comes to the following conclusions:

The influence of attention during sleep is incontestable.

Waking in relation to a fixed hour takes place in the great majority of cases before and not after the moment fixed upon.

Sleep during the nights in which the subjects ought to waken themselves at a definite hour—the attentive sleep as we have called it—is different from the sleep of other nights.

The errors are greater when the individual sleeps in the day than at night.

As physical indications of attention were observed with some subjects sensible acceleration of the heart, and at certain moments a sort of agitation about twenty minutes before the moment of waking.

6. The rapidity with which sleep can succeed a phase of waking activity, and the lucidity which follows immediately after waking, are well explained by the hypothesis of instinctive inhibition. Everyone has noticed this. People who pass the night watching with a sick person, in the many times of waking and dropping asleep, furnish illustrations of this. Also the great difference in the sleep when one goes to sleep with the sense of responsibility and when one is free from care, is hard to explain by the theories of intoxication or the like.

7. Sleep can be postponed. It is easy to explain this fact by the theory of instinctive reaction.

The instinct of sleep at a given moment may be the preponderating one, and again the instant following this may yield to some other. For example, when an animal prepares to go to sleep the sudden advent of danger immediately overcomes the desire for sleep. This had notable illustration in the war.

The soldiers, under the great fatigue of continued fighting and marching, often became extremely fatigued, and it is reported they would drop off to sleep whenever there was a chance, but rouse again when attacked by the enemy. The following is one report.

"All my men are very cheery, but very tired," was the report of one general at a most critical time. "Being attacked," he says, "was the only thing that kept them awake. Towards the end of this fighting they had a drunken craving for sleep and slept standing with their heads falling against a parapet, slept sitting hunched in ditches and slept like dead men when they lay in the open ground, but they waked again when the enemy attacked once more, and fought him and killed him, and dozed off again."

8. The reaction of the instinct of sleep, like those of all complex instincts, is more than a simple response to a stimulus. The various actions involved are coördinated. This is well seen in the preliminary preparations made before going to sleep both by animals and man.

9. In plethysmographic experiments Brodmann has observed that at the moment when sleep occurs the brain is the seat of vaso-dilation. Claparède raises the question whether this does not indicate that at this moment the encephalon is the seat of a special activity.

10. The curves of sleep published by different investigators strikingly resemble the curves of work and fatigue, whether muscular or mental, as found by Mosso and Kraepelin. The continued rise of the curve representing the depth of sleep during the first two hours is comparable to the rise of the curve of work under the influence of *Anregung* or excitement.

Again the curves of sleep, notably those published by Michelson and De Sanctis and Neyroz, present a series of oscillations. These oscillations are comparable to the sudden modifications in the curve of work which Kraepelin refers to distractions and to voluntary or instinctive reactions against these distractions, *i.e.*, to the effects of the *Störungsantrieb*. It is as if the organism, sleep being menaced by distractions, made an effort to reinforce the inhibitory process.

If sleep is an instinctive reaction to certain stimuli, then we should expect that at any time when the necessary stimuli are present, and other stimuli excluded, this response would occur. The investigations of Dr. Boris Sidis on animals and children, and the observations of physicians and others, indicate that this is true.

Dr. Sidis (28) has pretty clearly shown that limitation and monotony of stimulation cause sleep. He cites Heubel, who way back in 1877 noted that the cutting off of all external stimulation tends to bring about a languid condition akin to sleep. When attention is relaxed or interest in external impressions gone, drowsiness supervenes; thus prisoners in solitary confinement, unless they find a source of mental activity by getting some external stimulation, have a tendency to sleepiness. By the limitation of voluntary movement a mass of muscular and kinesthetic sensations are kept out of consciousness, and the result is a lowering of mental activity. He notes also that the cutting off of external impressions is of importance in hypnosis, as when the subject is asked to keep very quiet and make his mind a "blank." Where there is a predisposition to states of dissociation the result of limitation is not sleep but hypnosis, with a fall of thresholds.

"The most important and possibly fundamental condition common to sleep and subconscious states in that of *monotony*. In order to fall asleep we must dismiss all our interests, all our thoughts. Similarly, to induce hypnosis we tell the subject to try not to think of anything. We impoverish, we make *monotonous,* his mental life by making him think of 'nothing in particular.'"

Dr. Sidis (28, p. 41), from his experiments both with animals and children, has given very striking examples of sleep as an instinctive reaction to a definite situation where the stimuli are monotonous. The following illustration from the experiments with dogs is representative.

"Two puppies of about two months old; very lively, excitable, and barking violently. After some struggle each one was wrapped in a cloth so that even the forepaws did not protrude. At first they were greatly excited by the proceeding and proclaimed their indignation by loud yelping. I took my turn with each one separately. The puppy was held down firmly and given no chance to move its body or to struggle with its paws. I also closed the puppy's eyes with my fingers. The puppy struggled and wriggled under my hand, but I held on tightly. Gradually the puppy ceased its struggles and became very quiet. Respirations became slow and regular. I gradually released my grip on the dog, when I found that its eyes were firmly closed. The puppy was fast asleep. The same performance was carried out in the case of the other puppy. After five minutes, during

which time I held the dog tightly and kept all the extremities in close grip, the puppy passed into a quiet state and fell asleep as the first one did. Respiration was slow and uniform. Both puppies slept peacefully. There was no response to external stimuli. Limbs were in a state of relaxation. In spite of the noise in the neighboring room the puppies kept on sleeping."

In the case of young children Dr. Sidis' method of experimentation was similar; especially conducive to sleep were the sensations produced by monotony and the limitation of the coenaesthesia or the bodily sensations, brought about by pressing the abdomen, rocking the body, and the like.

Claparède's theory was formulated before the recent experimental studies of insomnia in dogs by Legendre (17) and Piéron (21). The results of these studies have added to our positive knowledge of sleep, and yet these results are not in conflict with Claparède's view. As Legendre (17, p. 600) himself says, the theory of Claparède "reaches beyond the sphere of pure physiology into that of psychology. Nevertheless, it offers a new field of activity for the physiologist."

These experimenters kept dogs awake for periods varying from 30 to 500 hours and obtained evidence of the presence of a hypnotoxin, not to be found in the blood, but in the brain and cerebro-spinal fluid. Histological examinations of the animals after insomnia showed distinct objective changes in the cortex of the pre-frontal region; the cells were diminished in size, the nuclei displaced and the Nissl granules in a condition of chromotolysis. The serum or the cerebro-spinal fluid of these animals exhausted by loss of sleep was injected into normal animals, and in about half an hour produced an imperative need of sleep. The animal showed the characteristic symptoms, and its brain also presented the characteristic lesion of insomnia. Injections of the cerebro-spinal fluid from a normal animal under similar conditions had no effect whatever.

According to the report of these investigators (17, p. 601), "Even under these conditions prolonged loss of sleep is always very serious, and after about 10 days the animals have generally reached the limit of resistance. During the entire period of this wakefulness the need of sleep becomes more and more imperative, and one can see among the seeming physiological factors of sleep those which tend to increase it and affect the need of sleep and those which do not disturb sleep and consequently can not be considered as its causes. The temperature of the body remains normal, the respiration undergoes no variation, and the amount of carbon dioxide in the blood does not increase, which enables us to exclude the theories of the impoverishment of the blood in oxygen and its enrichment in carbon dioxide as actual causes of sleep. Neither the blood nor the brain lose their portion of water, and this fact combats the theories that explain sleep by dehydration. Toward the tenth day the animal can no longer keep

its eyes open; its paws are continually bending, it has lost all sensorial activity and only the strongest kind of stimulation will induce reaction. At this moment the brain shows cellular disturbance, localized exclusively in the frontal lobe, such as could not have been brought on by other means, and which, therefore, seems to be characteristic of insomnia. If such an animal is left to sleep at will, he plunges into a deep sleep, from which he awakens completely refreshed, normal, and the alterations in the brain have then disappeared."

Legendre in his investigations raised the problem, suggested by Claparède, what is sleep a protection from, and attempts to answer this from the results of his experiments. Without attempting to solve the problems involved, Legendre answers this question by the conclusion that in general the protection is from poisoning by the hypnotoxin produced in the brain during a prolonged period of waking.

Claparède's theory covers all the different forms of sleep and related conditions; and the modifiability of instinct enables us to understand the variations of sleep and the causes of drowsiness, awakening, and the like.

Shepard (27, p. 77), in his excellent study of circulation and sleep, comes to a conclusion substantially in harmony with that of Claparède and maintains that sleep is a mental process controlled by conditions similar to the conditions of attention. He says:

"The oncoming of sleep may be greatly influenced by one's surroundings. This does not always mean that sleep is promoted by withdrawing from external stimuli; one who is accustomed to sleep much under the influence of certain external stimuli may demand their presence. Sleep is promoted by the situation in which we have really become accustomed to sleep. One may learn to sleep best in a given environment, just as one may learn to give attention to anything, or to work best in a given environment. One may even learn to sleep in a position which requires the continued contraction of a certain set of muscles in order to maintain his balance. It may be more difficult to wake up than to keep awake sometimes, just as it is difficult to shift attention when it is once absorbed in a subject. Sleep is controlled by conditions similar to those which control attention generally. Sleep and sleeplessness are mental processes."

Claparède's theory of sleep is not demonstrated. It is, however, based upon facts and in harmony with our general biological knowledge. This theory is at least a good working hypothesis. As we have seen, it does not conflict with any of the physiological facts that have been established; anaemia of the brain, accumulation of toxic products during the day, the loss of irritability in the nervous system, and so on, are

all conditions, not causes of sleep. It is noteworthy that some of the most important recent studies of sleep, by Legendre, Sidis, Shepard, and others, are in large part in accord with Claparède's theory.

The recent theories of the conditions of sleep, especially those of Kronthal (15) and Verworn (33) do not, it seems, necessarily conflict at all with the views of Claparède. In fact so far as Claparède holds that sleep is due to lack of interest these theories are distinctly in harmony with this view; and they throw light on the cause of this lack of interest.

In the words of these writers the imperative need of sleep is a result, not of exhaustion, but of cerebral fatigue, making the distinction established by Verworn. The normal destruction of toxic products is brought about by a process of oxidation during sleep. This process of oxidation goes on less rapidly during waking hours, and a dangerous accumulation occurs which is fatal to the life of the individual if the waking state is too greatly prolonged, as shown by experiments of Agostini and of Daddi.

Thus it is true that all our life-activity involves processes of metabolism and the formation and accumulation of toxic products. When these toxins accumulate in sufficient quantity to become dangerous the organism naturally protects itself against the poison. This it does par excellence by a period of sleep when the breaking down of tissue is reduced to a minimum and the processes of assimilation predominate over those of dissimilation.

According to Claparède the idea of life does not involve any idea of repose or of sleep. These are phenomena contingent to activity not necessary to it. Life implies nutrition, it does not imply at all the phenomenon of sleep. The state of sleep as a restorative would affect the activity of the organism only in the following cases: First, if the organism expends more rapidly than it acquires. Second, if the toxic products of organic combustion are eliminated less rapidly than they are formed.

One can easily conceive of organisms in which the building up processes exactly compensate for the expenditure, and in which the toxic products are eliminated in a degree corresponding to their formation. Here, sleep would not be implied in the idea of life. In fact, it would not appear to be an advantage. Inferior organisms, such as the microbe, it is maintained, do not sleep. According to the study made by Hodge and Aikins (12), the protozoa do not sleep. At least they found that the vorticellae worked incessantly during a period of 21 hours. These animals never sleep.

"With food in abundance," say the writers, "capable of yielding a continuous supply of energy, it is a strange physiological paradox that all animals should not be able to work continuously. For any of the higher animals, at least, this is not possible. . . . It seems only reasonable, however, that protoplasm may be formed as fast as used under favorable conditions of nutrition, and that with equally good facilities for the removal of decomposition products, these may not accumulate in amounts sufficient to interfere with activity. So far as we are able to interpret the significance of our own experiments, this is the state of things in a Vorticella under favorable conditions of life."

Animals need, in the struggle for existence, the power of intense activity, and hence they become exhausted. On account of the law of momentary interest it is necessary that repose should precede exhaustion. Animals which have slept before becoming completely exhausted have thus had an advantage in the struggle for existence and have been preserved by selection. Most animals having reasons for being active in the daytime, it is not surprising that they have been fatigued at night and have slept. Those which have been obliged for other reasons to be active at night have been fatigued in the morning and slept during the day.

One other theory, that of Stekel(30), although somewhat fantastic, is interesting and suggests the possible importance of the will, at least, in controlling the stimuli that tend to produce sleep. He goes much farther than Claparède and would make the reaction of sleep a voluntary reaction.

According to Stekel's theory, man sleeps because he wishes to sleep. Former theories have said man sleeps because he must sleep, he is forced to sleep. On the contrary he maintains that man forces himself to sleep. Sleep is a kind of autohypnosis. Excitement, feeling, is the stimulus that keeps one awake, and when the stimuli of the day are dulled, and interest in daily activities wanes, and in all cases when the individual becomes bored or blasé, the tendency is to sleep. For this he gives a fantastic reason, namely, that the unconscious, that limbo of primitive desires and passions and impulses, is more attractive to the individual than waking life. The unconscious is more exciting than the conscious. Thus, the more consciousness is developed, as in intellectual men and men of genius, the less one sleeps; and the less interesting consciousness is, the more one desires to drop back into the unconscious and sleep.

According to Stekel, attention and interest are the determining factors. Boredom, lack of excitement, lack of interest

in conscious life, are the conditions which bring about sleep, in which dreams always occur and in which the allurement of the unconscious is the dominant factor. This is why men of genius sleep little, because consciousness to them is exciting.

Thus to Dr. Stekel the will to sleep is a powerful hypnotic, and if the conditions are favorable, if the necessary stimuli are present, the response of sleep is likely to be continuous if the will to sleep is present.

None of the theories are adequate. The theory of Claparède is perhaps the most satisfactory. The essential of it is that sleep is a positive nervous function, an instinctive reaction of defence.

As Claparède sums up the matter, this new conception of sleep permits us easily to take account of all the facts which form insuperable obstacles to the passive theories of sleep, the chemical, toxic, and the like: lack of parallelism between sleep and exhaustion, the periodic character of sleep, the possible arrest of sleep by interest or volition, suggestion of sleep, partial sleep, the character of the curve of sleep, variety of types of sleep in animals and so on. This conception permits us still further to look upon the hibernal or aesteval sleep as a parallel of sleep descended in a direct line from ordinary sleep and a phenomenon of secondary adaptation.

As to the mechanism of sleep, it consists in a reaction of lack of interest for the present situation. It is not, as is usually believed, the irritability, the receptivity, which is weakened or abolished in sleep, but it is the reactivity, notably the reactivity of interest and of adaptation. The psychology of dreams justifies this way of looking at the matter.

To understand this theory of sleep as an instinctive reaction one should keep in mind three things: (1) That all of the time, even during sleep the organism is reacting to stimuli of various kinds. (2) That the stimuli to which sleep is the instinctive reaction are of two kinds, internal stimuli, feelings of fatigue and the like; and second, external stimuli, darkness, the sight of a special location, a couch, perhaps, and so on. (3) In a situation which produces sleep, the external stimuli are reduced to a minimum and usually are monotonous in character, while the internal stimuli remain active.

A few recent investigations concern a number of points that should be considered to make clearer this view of sleep as a reaction to stimuli. Without any attempt to give the results fully, the different points may be presented roughly as follows:

(1) First is the case of hibernal sleep. According to Claparède this is a response to stimulation. The animals that

fall into lethargy during a certain period of the year are those whose habitual nourishment is lacking at that time. The hibernal sleep is thus regulated by the law of momentary interest. No food is present to keep up their interest in eating. And in other ways this law of momentary interest is shown. It is similar to daily sleep; it is the result of a habit acquired by animals of passing the winter in a cave where they had stored their food.

Many factors probably act as stimuli, among these the following: perception of the lack of food, a low temperature, humidity or dryness, perhaps certain odors peculiar to the season of the year which escape our olfactive sense. Finally, as in the case of instinct in general, internal factors coöperate. The animal goes to sleep when he feels ready for this function. Horvath tried in vain to put his squirrels to sleep in the summer time. It is probable that this readiness for hibernation is principally due to the animal's condition of nutrition. Forel's dormouse was very fat at the time when he went to sleep. Recent studies by Cushing and others show changes in the pituitary gland.

Finally the hibernal sleep is not a simple act but a total reaction of the organism involving a series of coördinated activities. The animal seeks for a cave or shelter. It prepares its bed, curls up in the proper position, and so on. The animal in captivity makes this necessary prelude to sleep. The biological significance of this act is evident. It is an instinct of preservation.

According to Claparède the hibernal sleep of animals and ordinary sleep are similar in character. Some writers have said that hibernation has nothing to do with natural sleep; but in his theory of the positive nature of sleep Claparède finds the bridge between these two classes of phenomena. Dubois has also attempted to show the correspondence between the two; but according to him both are alike in being examples of auto-narcosis. According to Claparède, on the other hand, they are similar because both are instinctive activities.

A large number of observations have shown that hibernal sleep is an instinct. Certain animals like the tanrec of Madagascar fall into lethargy during the dry season and awaken as soon as the rain comes. Others like the dormouse sleep in the summer in the torrid zone and in the winter in the temperate zone.

It is obvious, argues Claparède, that the hibernal sleep is not a passive and contingent phenomenon, but on the contrary it is adapted to a specific end. The animals which fall into lethargy during a certain period of the year are those whose

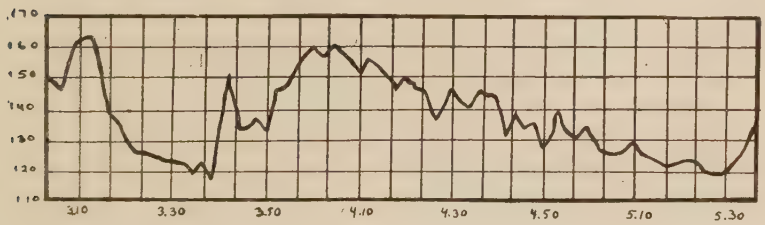
habitual food is lacking during that period. The hibernal sleep thus has for its end to hinder certain animals from expending their forces at a time of the year when, for lack of food, they cannot repair them. This sleep has the same biological reason as the migration of birds to escape starvation. It is an act of the whole organism manifesting a certain elasticity since it can be postponed several months according to surrounding circumstances.

(2) The experimental evidence shows that men and animals fall asleep when placed in certain situations; that is, subjected to certain groups of stimuli. More concretely when a child or an animal is put in a dark room and the stimuli are reduced to a monotonous sequence, by wrapping the dog or child in a blanket, for example, sleep occurs. The response of going to sleep here also is to a group of stimuli internal like the sensations of fatigue from the monotonously repeated sound or what not, the reduction in the metabolism, perhaps, and similar conditions, and external stimuli, darkness, a monotonous environment, and the like.

In any case, the reduction of the external stimuli, the presence of certain stimuli that suggest sleep or are conditioned stimuli for sleep and the continuance of certain internal stimuli, are the essential conditions.

(3) In sleep the stimuli are reduced, but by no means excluded. As already noted, the organism is continuously responding to stimuli of various kinds, as has been amply shown by recent investigations.

Again the experiments on the sleep of children give evidence that the condition of sleep itself is one of continued response to stimulation. Not merely do the fundamental physiological processes, the heart beat, respiration and digestion continue, but the metabolism is by no means constant and unvarying; on the contrary it is subject to many and wide variations, as shown in Benedict's experiments, with the kymograph. Of the many cases reported in Benedict and Talbot's excellent study (2, p. 119) one example of the variation in the pulse is presented in the figure below.



The authors compare the pulse record and the kymograph record as follows:

"The kymograph record shows that after a period of activity from 3h 3m p. m. to about 3h 16m p. m. there was a short period of comparative quiet, *i.e.*, from 3h 16m p. m. to 3h 36m p. m., and that the last period from 5h 07m p. m. to 5h 31m p. m. was also sufficiently quiet to be characterized as activity III. The remainder of the time the infant was quite active, so that experimental observations of the minimum metabolism were impossible. A close examination of the kymograph and pulse curves shows that there is a striking parallelism between them. Thus, from 3h 03m p. m. to about 3h 16m p. m., the infant was restless, with a high pulse-rate, while between 3h 16m p. m. and 3h 36m p. m. the activity was at a minimum and the pulse-rate was low. About 3h 39m p. m. the pulse-rate again rose, the rise being accompanied by increased external activity. This reached a maximum about 4 o'clock and a period of decreasing activity followed until the infant became quiet at about 5h 7m p. m. From that time until it waked up, just before the end of the observation, the infant was quiet with a minimum pulse-rate. Thus we see complete uniformity in both curves."

(4) The whole matter of response to stimulation in sleep is extremely complex. We should keep in mind that there are many stimuli and some may be excluded while others are definitely active. This in large part accounts for the phenomena of so-called attentive sleep. The relation of sensation to stimulation naturally remains the same whether we are asleep or awake, and the ordinary psychological laws as regards sensation and stimulus hold.

As every psychologist knows, we are conscious of a stimulus only when it reaches a certain intensity called the threshold or limen. Again "the increase of the stimulus necessary to produce a just perceptible difference in the sensation bears a constant ratio to the total stimulus." Activity of the sense organ raises the threshold, i. e., decreases the acuity.

In other words, as Weber showed long ago, there are two limens or thresholds. First a stimulus must have a certain intensity or we feel no sensation. Again when a stimulus is acting which produces a sensation, if we are to have any increase or change in the sensation the stimulus must be increased in proportion to the already existing stimulus. Thus the real actual limen always depends upon the amount of stimulus that is acting. When we go to sleep under conditions of monotony, that is, when stimuli are acting with a certain intensity, we do not note a change of sensation unless the stimulus is increased. Thus as we drop asleep the limens are raised. And so too, as this change in limen may be different for different sensations, being low for one and high for another, we may, as Sidis puts it, be awake for one stimulus and asleep for others.

From these facts in regard to the changing limen for sensations, Dr. Sidis (28 and 29) reasons as follows:

"In the course of the daily activity of the individual the thresholds of sensitivity and of sensori-motor reactions in response to the stimuli of ordinary life rise gradually, the stimuli fall below the threshold of living reactions. The mass of stimuli of the external world constituting the external environment of the individual drops out of the life-cycle of the individual and for the time being ceases to exist for him. *The individual is asleep, asleep for that environment.* In other words the stimuli of the external world by their continuous action have become monotonous, have raised the thresholds and have become excluded from the life existence of the individual who is now deeply asleep for that given environment."

"Should an appreciable variation occur in the environment at about the time when the organism is ready to fall asleep *the external world becomes again a living reality.* The individual becomes alive and wide awake to what is going on around him. If an appreciable change in the total mass or in some stimuli constituting the environment takes place, the individual may be awakened out of his sleep. Should the variation occur in some of the stimuli, their thresholds become lowered and the individual, though asleep in regard to all else, is awake in regard to them. This partial waking state is the soil in which dreams develop most luxuriantly. *We do not dream, when we are asleep, we dream, when we are awake.*"

In general Sidis finds that sleep is not so much due to merely cutting off sensory impressions as to the monotony of sensory impressions, which may in fact be intense and numerous. "It is the invariability of sensory impressions that reduces the organism to the passive state which we experience as sleep."

(5) Are the conditioned stimuli. Whether the usual associated stimuli producing conditioned reflexes persist in sleep, depends on the stage of sleep. Apparently they are entirely abolished in deep sleep.

A remarkable study of sleep has been made in Pavlov's laboratory in connection with the experiments on the conditioned reflex. The results are reported in part as follows:

Rojansky has studied sleep as manifested under the influence of uniform and indifferent stimuli, for example, in the environment in which the animal is to be experimented on. When the dog is placed alone in the room on the table, he gradually falls into a state of drowsiness and then into pro-

found sleep. Another kind of sleep is manifested under the influence of active determined stimuli, which they used as strong conditioned stimuli. Under the influence of such stimuli with all of the dogs, with special rapidity in the case of some of them, the state of hypnotic sleep appears. Finally Woskressensky (20) produced a condition of tranquil sleep.

Careful examination of the details of the experiments on the dog showed that sleep occurred under the following conditions. In experiments made by Mme. Pavlov (20) the experiment was begun when the dog was placed on the table. Without making the dog give attention they applied special conditioned stimuli, nourishment serving as the unconditioned stimulus. In these conditions sleep did not occur. In other experiments the dog was kept for a relatively long time on the table before beginning the experiment. With these uniform conditions of the environment a condition of sleep began to manifest itself. The conditions of this sleep were carefully studied and were very interesting.

When all the preparations, arrangements of the apparatus and so on, had been completed and the experiment began immediately, the animal being subjected to the habitual stimuli, sleep did not occur, but if after the completion of the preparation and the beginning of the experiment a single minute was allowed to elapse, immediately the first stage of sleep occurred. If 10 minutes were allowed to pass after the preparations were completed, a second phase occurred, and thus one could gauge the hypnotic power of the environment and study the course of sleep.

The following results were established: Habitually in these experiments there were two reactions of the animal, on the one hand a secretory reaction, the flow of saliva; on the other hand a motor reaction, when the dog was given food. In other words, there were two reflexes, a motor reflex and a glandular reflex. The following table shows the results (20, p. 1081).

Condition of Dog	Phases of sleep	Reflexes: Secretory	Reflexes: Motor	Observations
State of waking	+	+ (1)	+	
State of sleep	I	—	+	Deep sleep
	II	+	—	
	III	—	—	
	II	+	—	
	I	—	+	
State of waking		+	+	

[1] The sign + designates the presence, and the sign — the absence of the reflex.

These investigators give in substance the following explanation of the results in the table: If we begin the experiment immediately after the preparations for it are completed, the animal keeps awake. The secretory reflex and the motor reflex both occur. Saliva begins to flow when the conditioned stimulus begins to act and the dog takes food when given to him. But if we keep the dog under the influence of the environment about two minutes, that is, if two minutes are allowed to elapse after completing the preparations before beginning the experiment, the first phase of sleep occurs. The secretory reflex disappears, the conditioned stimulus does not act, but the motor reflex does persist. If we give a bigger dose of the hypnotic environment, so to speak, that is, if we leave the animal about 10 minutes after the preparations are completed before beginning the experiment, then a more profound sleep occurs and a different reaction. The saliva is secreted, but the motor reflex is absent. This is the second phase of sleep. Again, if the dog is left for half an hour before the experiment is begun, then complete deep sleep occurs and both reflexes disappear. In waking the animal up, if he is wakened gradually, then similar phases occur in reverse order.

As they formulate their conclusion, these results seem to show that a localization, even a displacement of the condition of sleep over the mass of the cerebral hemispheres occurs, and the hypothesis is suggested that this inhibition of sleep occurs in a definite part of the hemispheres.

(6) If sleep is an instinctive reaction, the question may naturally be asked why, in case of a monotonous environment, and where the stimuli to sleep are continuously present, one should not continue to sleep and not awaken at all except when the need of food or the like required. There is some evidence that this is the fact.

Primitive people often sleep a great deal because they are unoccupied and there is little to fix their attention. A friend tells me he is accustomed to sleep whenever he rides on the steam cars; for, as he says, there is nothing to interest him.

Young children, when properly fed and protected, sleep a large part of the time, as everybody knows. People who have nothing else to do are apt to sleep long hours. The Russian peasants in some sections have been reported by one writer as passing the winter in a condition approximating a state of hibernation. Mr. Louis N. Wilson, who has spent many years in Russia, says that this is largely true. In many districts there is nothing to do, the father of the family crawls up onto the big stove, the warmest place in the room, and stays

there all the time except when his wife makes him come down to attend to some necessary work.

Most remarkable are the cases of certain individuals who have slept for long periods of time. The most remarkable case of all is that reported some years ago in the Nouvelle Iconographie de la Salpetrière, Vol. 25, 1912, and cited by Stekel(30).

The case was that of a Swedish girl who slept for 32 years. This remarkable case occurred in the little village of Oknö and excited the whole of Sweden. Born in 1861, in 1876, when about 14 years of age, this girl, Caroline Olson by name, came home one day, complained of toothache and went to bed. She is said not to have left her bed until 32 years later in the year 1908. She awoke only occasionally and is said to have spoken only a very few words during the whole period. Her nourishment consisted of only two glasses of milk a day, and it is said that the function of nutrition was so greatly reduced that her brothers and father maintained that it was altogether arrested. This is not true, but the metabolic processes were greatly reduced. Frequently a physician was called; once she went to the hospital, and after 15 days the disease was diagnosed as hysteria. The father maintained that three or four times during the 32 years he saw her crawling about on the floor, and once in his presence she called out "dear Jesus have pity on me."

The mother cared for her daughter constantly, but died in 1905. The death made some impression on the girl. When the father informed her she began to cry, but afterwards became quiet and went to sleep again. After the mother's death a governess came into the house, who was less lenient toward the patient's hysterical behavior. She suspected that Caroline had gone to the kitchen in her mother's absence and helped herself. The governess took better care of the food and Caroline went hungry, and this perhaps was the motive for her suddenly getting up and taking up the work of life.

On the critical day of reawakening, Caroline was found crawling about on the floor and weeping. She kept always crying out "Where is mamma." When her brothers came home she did not recognize them and said "They are not my brothers, for they are small." She was greatly emaciated, her skin transparently pale like that of a man dying from hunger; but on that day she began to take up her life again, had a good appetite, could read fluently, spoke with one of her schoolmates of the past; and 14 days later, got up and took part in the housework, although her movements at first

were lacking in skill. She never spoke of the past. It was as if a thick veil were drawn over the whole period.

Dr. Toedenströn emphasizes the fact tthat Caroline looked remarkably young. She had slept the whole period from puberty to the climateric, the whole period of womanhood. She was a child and wished to remain a child. Dr. Stekel thinks that her questioning after her mother when she awoke indicated the disorder called psychic infantilism, although this seems very slim evidence.

This is the most remarkable case on record, but many others somewhat similar have been reported. Dr. Stekel cites a newspaper report of the case of three maiden ladies in Prague. In a quiet house in that city lived three sisters, and for some days nothing was heard from them. They were not seen on the street; the doors of the house remained closed. The neighbors suspected crime, or that they were ill. The police were informed; they broke into the house and found the three sisters all asleep in their beds, barricaded as if they had retired to a fortress, and very unwilling to be awakened. Their purpose was to sleep through the whole of the war. They would hear nothing more of all the cruelties, of all the bloodshed and sacrifices of fighting. They wished to sleep and to awaken when peace had come. It appeared that they would have slept for many months if they had not been awakened.

The Hygiene of Sleep

The importance of the hygiene of sleep is realized if we recall a few facts. It concerns a third of life directly, the health and efficiency of our whole life indirectly. In the early years it concerns half of life directly. Prolonged lack of sleep results in the production of a special toxin. Insomnia is not only an evil in itself, but made worse by the unnecessary fears apt to be associated with it.

About all the physiologists give us is a general statement in regard to the hygiene of sleep. Stiles, in his excellent Physiology, for example, says that we do not know whether one should sleep 5 or 6 hours or more than that; that the best sleep is that which seems to have been dreamless, as we look back upon it; that it is a sign of nerve fag when the thoughts of the night closely resemble those of the day.

Plenty of books give instruction in regard to the way to go to sleep and the way to avoid insomnia; but while the directions are often delightfully simple, an attempt to apply them practically may fill one with disgust.

Among the popular opinions in regard to sleep it is maintained by some that intellectual work after the evening meal

is bad, others resort to reading as a narcotic; it is held by some that exercise is bad, and by some that exercise will produce sleep; by some that eating just before retiring is an advantage, by others that it is an injury; by some that a bath is good, by others that it keeps one awake; by some that one should get to bed at a regular hour whether sleepy or not, by others that it is well to stay up if wide awake; some have special devices for producing sleep, others get up if they cannot sleep and make the best of it.

Clearly there are certain deeper underlying principles to be considered. First of all are the individual differences. As regards one's relations to the goddess of sleep they must always be individual and personal; but one further generalization seems to be established. The reason one cannot sleep when in the customary situation for sleep, i.e., ordinarily when one goes to bed in a dark room, is that the excitement of waking hours persists. Mental activity does not cease when we lie down, as does our bodily activity. Thus, as everybody knows, sorrow, anxiety, fear, worry, great joy, or strong emotion of any kind, keep one awake. Hence the conflict of opinion in regard to food, exercise, and the like. If study at night leaves one in a condition of persisting excitement, or if physical exercise, or social entertainment, or a bath, or reading, or food, or drink does this, then such things keep one awake. If, on the other hand, one is not physically weary, a walk or the like may reduce the excitement. A light lunch may do the same, reading may help, and even rather violent activity or energetic expression of emotion, by causing a normal explosion of energy, may reduce the excitement and bring about sleep.

Thus the more completely we can shut out sensory stimuli and relax attention, the more likely we are to sleep. Whatever causes persisting excitement is likely to cause sleeplessness, whatever reduces the excitement is likely to produce sleep. It all depends on the character of the individual on the one hand, and the temporary condition of the individual on the other.

A few things of practical significance can be briefly stated. First of all are the so-called substitutes for sleep. Most of them are helpful chiefly perhaps, because they prepare the way for normal sleep rather than for the benefit that comes from them directly. Among them are the following:

(1) The condition resembling sleep that comes from the use of various drugs. A large number of hypnotics are now on the market and widely used,—sulphanol, trianol, paraldehyde, chloralimede, and the like. According to Stekel many

persons are addicted to the use of these drugs. It is doubtful whether they cause genuine sleep or not. Verworn maintains that they do not, that, on the other hand, they cause a condition of asphyxiation so that the nerve cells cannot appropriate oxygen normally. Their value comes from the fact that they quiet the nerves, and normal sleep follows after the drug effect has passed away. In some cases it is necessary to use them; but apparently, where sufficient, it is better to use the bromides to quiet the nerves rather than the hypnotics.

(2) Is the hypnotic sleep. Deep hypnosis has been used in some severe cases of hysteria with helpful results. The patient is put into deep hypnotic sleep and kept asleep for days or weeks at a time. This method does not seem to be in favor, and probably should be used only in most extreme cases.

(3) Some people who are forced to keep awake for long hours find it helpful to take an additional meal, which is often needed on account of the unusual activity of the person. This in many cases may prove helpful also in bringing about sleep.

(4) Is the use of neutral baths. The neutral bath is merely a bath at body temperature; and an individual can remain in this for a long time. Some find this an especially helpful substitute for sleep, and the advantage of it again is that it is very likely to bring about refreshing sleep afterwards. Some find it an advantage to sleep in the neutral bath if they can do so. It is said to have a wonderful effect in quieting the nerves. It is the standard remedy in the excitement of manic-depressive insanity.

(5) Is a condition of approximately absolute rest. Benedict found that if a person can sit quietly in a chair and make no movements and do nothing whatever, the metabolism is reduced as much as in sleep. Especially is it desirable that attention itself should be in abeyance.

The condition last mentioned is so important that it should be considered somewhat in detail. The experimental studies, especially those of Sidis, show the importance of subwaking states. What Sidis distinguished as the hypnoidal state seems to be merely a condition in which attention is reduced to a minimum or at least functions on a low level; and, as already noted, this seems to be the condition out of which sleep, on the one hand, and hypnosis on the other, are easily developed. A condition approximating this with relaxed attention is perfectly normal and probably the best substitute for sleep and the best preparation for sleep.

A delightful illustration of this normal condition of reduced attention has been given by Mr. W. H. Hudson in his interest-

ing book, "Idle days in Patagonia." Mr. Hudson describes his experience in part as follows:

It was his custom, he says, to go out every morning on horseback, into the grey, universal thicket, where he was all alone. Day after day he returned to this solitude and yet he had no object in going, there was nothing to shoot, the weather was cheerless, there was nothing novel to be seen. "All day there would be no sound, not even the rustle of a leaf;" but he wandered aimlessly at a slow pace, and at noon time would rest, although he was never tired, in a little grove of trees that he had selected apparently at random and for which he formed an habitual apperception, probably conditioned reflexes that favored his rest. He says:

"But during those solitary days it was a rare thing for any thought to cross my mind. In the state of mind I was in, thought had become impossible. My state was one of *suspense* and *watchfulness;* yet I had no expectation of meeting an adventure, and felt as free from apprehension as I feel now while sitting in a room in London. The state seemed familiar rather than strange, and accompanied by a strong feeling of elation; and I did not know that something had come between me and my intellect until I returned to my former self,—to thinking, and the old insipid existence again."

"I had undoubtedly *gone back;* and that state of intense watchfulness or alertness, rather, with suspension of the higher intellectual faculties, represented the mental state of the pure savage. He thinks little, reasons little, having a surer guide in his (mere sensory perceptions). He is in perfect harmony with nature, and is nearly on a level, mentally, with the animals he preys on, and which in their turn sometimes prey on him." (Quoted by James, "Talks to Teachers," p. 262.)

Attention is an instinctive reaction genetically similar to the tropisms of plants and animals. In any of the higher animals a hierarchy of habits based upon this fundamental reaction is likely to be developed, and the lower and more fundamental may exist along with the higher and more complex. The individual often retains the power of dropping back into lower and more fundamental modes of activity, and this is often done with the distinct feeling of satisfaction that we may often observe in ourselves. For example, as Dr. Gulick has noted, on the beach in a summer vacation when we dig idly in the sand or let it trickle through our fingers. This ability to fall back into lower and more generic forms of instinctive activity is distinctly desirable.

It would be of the greatest value to many business men and other intellectual workers if they could acquire the habit of relaxing, whenever opportunity permits, into such stages of attention. If the habit of working hard and with intense concentration for short periods were acquired, it would be possible for most men to find opportunity several times in the

day to drop back into this more primitive condition of attention. Many great men, General Grant, President Harper, Dr. Pepper of the University of Pennsylvania, and others, have had the power of dropping asleep whenever opportunity offered, on the battle field or in the office. Few men can acquire this habit, but most people can acquire the habit of relaxing to this more primitive level of mental activity. To use a crude mechanical illustration, this is similar to dropping from high speed into low in climbing a hill with an automobile, and probably is as great a saving of strain.

While such complete rest with relaxation of attention is apparently the best substitute for sleep and the best preparation for it, nevertheless it should be noted that fatigue and insomnia are two very different things. The investigations by Piéron have shown that muscular fatigue, for example, does not necessarily indicate a need for sleep; and on the other hand the imperative need for sleep that results from prolonged insomnia does not necessarily mean fatigue. Thus it may happen that an individual suffering from insomnia may be better off engaged in certain occupations than attempting to rest when not really tired.

Practical Rules

Assuming then for the time being that sleep is an instinctive reaction we have noted that, like the other great instinctive impulses, it rests upon the fundamental characteristic of the human organism as a mechanism for reacting to stimulation. Likewise, just as in case of the other instinctive reactions, there are liable to be inhibitions, perversions, and latency of this instinct, it is always relative to other instinctive reactions, may take the place of them or in turn be inhibited by them; and connected with this, perhaps differentiated from it, are many related phenomena such as hibernation, aestavation, hypnosis, drowsiness, the hypnoidal state, and the like. From this, or on the basis of this, habits of response are built up, and associated stimuli in vast variety may bring about this reaction as a conditioned reflex. Of concrete hygienic suggestions the following are important.

(1) Of course the ordinary commonsense rules should be followed, and children should be trained not to take tea or coffee or hearty and stimulating food nor engage in exciting occupations just before going to bed.

(2) It often happens that special preparation for sleep is necessary. The poets have rightly represented sleep as a goddess whose favor must be wooed. From the point of view of hygiene this is the correct attitude. We cannot expect that

this proud and fickle goddess will grant her favors to those who come to pay their respects directly from all kinds of selfish activities, exciting and frivolous occupations, or even from absorbing and strenuous labors. On the contrary, people are often too tired to sleep and must rest for a time; and again the activities of the day are too exciting, and the goddess will grant no favor until this excitement and turmoil have passed away and a more serene and proper frame of mind acquired. All of the various substitutes for sleep may thus be helpful as preparation for sleep itself.

Dr. Sidis (28, p. 10), describes a method he has tried as follows:

"I began to experiment on myself and found that I could put myself almost at any time into a state of deep sleep by closing my eyes and keeping perfectly still, dismissing all ideas from my mind—closing shop, so to say. I was able to put myself into a quiet, prolonged and often very refreshing sleep. I have further succeeded in the treatment of many cases of insomnia, by following the same lines, in bringing about good therapeutic results."

(3) Especially is it important that children should be trained to make preparation for sleep. At the close of the day it is fitting that they should give up their more boisterous sports and occupations, sit quietly in the family circle, and rest from the more severe occupations of the day; such quiet hours are not only valuable in themselves for the mental health of the children, but the best possible preparation for the instinctive reaction of sleep.

The relation of dreams to health is another story not in place here; but perhaps usually, especially in case of children, if the work of the day persists in the dreams at night it is a sign of nervous fatigue. Children frequently continue their reckoning at night and are tormented with sums and other tasks of the school work. It is thought in general that when we dream it is a sign of normal dreaming if the dreams concern events long past and things that are not directly related to the day's work.

Whenever normal reaction to stimulation, especially strongly emotional stimuli, has been repressed, this is likely to interfere seriously with sleep. A repressed reaction of any kind may be a serious cause of insomnia, or may bring about the condition of attentive sleep. Especially the effort to solve a puzzling problem, whether concerning one's own conduct or a problem in mathematics, just before going to sleep, is likely to bring about the condition of interference of association which is characteristic of attentive sleep. Such problems

should always be avoided at night unless it is possible to solve them satisfactorily. And it is noteworthy that a very slight affective stimulus not normally reacted to may be sufficient to interfere with sleep.

Again children should be trained to settle their moral accounts every night and never to hold a grudge, but if they have any grievance or the like, to settle the matter before going to bed, and wipe the slate clean from all the worries and troubles of childhood. A wise and tactful mother can train her children in this way so that when they go to bed at night the mental attitude is serene, and attention, as well as muscular tone, is relaxed. Then the individual is likely to sleep normally; but if one goes to bed with anything special on the mind, then the condition is likely to be that of attentive sleep.

(4) A whole group of habits in regard to going to sleep are of fundamental importance; and to a large extent children can be trained to healthful habits by proper care. A large number of conditioned stimuli to sleep are developed in the early years, and these should be wholesome and desirable. Among those which should become habitual in the production of sleep are, of course, darkness, a healthful posture, and perhaps the sight of a couch, and the sensations connected with closing the eyes, and the like.

On the other hand, the habits developed in many children of going to sleep in the light, and of dropping to sleep in a bad posture, or without proper arrangement of the clothing and the like, are bad. And further, the sound of the mother's voice or that of the nurse in singing, reading, telling stories, the dermal sensation from rubbing, patting, and the like, while desirable on special occasions, are of doubtful value from a hygienic point of view as habitual conditioned stimuli. It is much better that the child should become habituated to conditioned stimuli naturally and normally present in an hygienic environment, namely, darkness, the sensation from a suitable posture, and good air. Distinctly unhygienic are of course the various artificial stimuli, such as pacifiers, soothing syrups, the presence of a dog or cat or other animal, and toys of any kind that cannot be kept suitably clean.

Since the sensation from any receptor organ may become a conditioned stimulus, and this is probably true for the reaction of going to sleep as well as for other reflexes, it is quite possible for many conditions to be helpful as adjuvant stimuli in bringing about sleep. Thus a man may be helped by smoking a cigar, by taking a light lunch, by reading a newspaper or reading what Oliver Wendell Holmes has called

nightcap authors, not merely because they soothe the mind and bring about a mental attitude favorable to sleep, but also probably in many cases because such reading involves conditioned stimuli that become associated with the natural stimuli to sleep. Thus sermon and lecture may have an hygienic and hypnotic value, and in some cases be especially effective. It was the poet Southey, if I mistake not, who tells of his struggles with insomnia and the various devices to which he resorted,—counting, repeating things learned by heart, the visualizing of an interminable flock of sheep jumping over a wall, or the like, but nothing was effective until he recalled his old lecture room in college, the voice of the lecturer, and the sleepy attitude of his fellow students. This at once was effective, and so after many years he found evidence of the hypnotic value of lectures.

(5) If we accept the view that the reaction of sleep is an instinctive reaction, it follows that the general principles applying to instinct apply to a large extent here. For example, it is never safe to fool with an instinctive reaction, as various perversions and inhibitions are liable to occur. Thus if children are continually wakened when they are still in need of sleep, or if they sleep with disturbing conditions, unfortunate habits of attentive sleep or even of insomnia may be developed.

(6) From a hygienic point of view, in accordance with what seems the natural sequence, sleep should precede exhaustion when possible. If one has a strenuous piece of work to perform it is better to have extra sleep before the task than afterward, since in the latter case not only is more harm done to the nervous tissue by the strain of nervous work, but it is often impossible to sleep in a condition of exhaustion.

(7) The time of sleep is apparently important. It is obviously much better to sleep at night than to sleep in the daytime, and yet there may be individual differences. Some take their sleep all in one dose, others, especially in hot countries, take it in two doses, and some find it an advantage to take many small doses whenever opportunity offers.

In our modern life, as pointed out in the recent article by Professor Patrick, the tendency is more and more to transfer the activities of the day to the night; and so more and more the day has been lengthened into the hours of darkness and the night extended into the morning. As an offset to this Professor Patrick emphasizes the distinct hygienic value of the daylight saving plan. He says (19a, p. 395):

"Probably the real reasons for our ever increasing night life are of a profound psychological nature. There are two distinct prin-

ciples involved here. First, artificial light exercises upon us a peculiar fascination not possessed by sunlight. This is due to certain mental associations coming down from the primitive life of man. Fire is the original source of artificial light, and fire and light are associated in the mind. The campfire or the fire on the hearth suggest feasting and joy after the labor of the day and in winter suggest warmth and comfort. After the strenuous labors of the day in forest and field comes the pleasant relaxation of the evening, and whether this takes the form of feasting or dancing or music or the telling of tales, the campfire is the center of this joyous social life. This deepseated association fixed by centuries of ancestral habit explains that peculiar feeling of pleasure which we have when the lights are lighted at night. When theatrical performances are held by day, no matter how well lighted the theater may be, we all prefer to darken the windows and use the electric lights, while the lure of the great city is partly due to the glitter of the brilliantly lighted streets and places of amusement."

(8) The amount of sleep is important. There are great differences in the dosage of sleep as well as in the way this is divided. Some seem to get on well with six hours of sleep, others need nine or ten.

Children should be habituated to long hours of sleep, 12 to 14 hours up to the age of 4; 11 or 12 hours to the age of 9; 10 hours to the age of 15, and thereafter 8 or 9 hours.

According to Stekel, there are the greatest individual differences as regards the need of sleep. He says that he himself needs at least five hours of sleep, suffers seriously if he does not have this; but on the other hand, is likely to feel uncomfortable if not ill when he has more than six and one-half hours. He cites Virchow, Mumson, and Goethe. Virchow needed only a few hours of sleep; and he maintains that men of genius usually need very little; men who are doing intellectual work need less than those performing muscular labor. He has found men who are active mentally and on an average completely satisfied with six or seven hours of sleep. Youth need more sleep than older people; active and bright children sleep less; and there are children who suffer from sleeplessness at a very early age. It is useless to lay down any general rules. The necessary amount of sleep is an individual matter.

(9) There seems to be danger from sleeping too much. Again, according to Stekel, many neurotic persons, dissatisfied with life, flee from the real world and take refuge in the world of dreams. Frequently they fight all night long with temptation and become so weary that they waken in the morning with dulled spirits and go to work with a headache. It is absolutely untrue that we can strengthen the nerves by sleeping a long time, says Stekel. On the contrary, the nervous individual should avoid too long sleep because his nervous-

ness rests on the fact that he lives in severe conflict between the demands of culture and the impulses of his passions. Many nervous people maintain that they have to sleep 8, 10, or 12 hours, in order to feel well. But nothing is more injurious for the nervous than too long sleep, Stekel maintains. And many cases of nervousness can be cured by stopping this over indulgence in sleep. People that sleep so much wake in the morning tired and dull, they are never satisfied, they are always fighting with the impressions of the night and do not feel well until toward evening. Among other bad results of sleeping too much are gallstones, stones in the kidneys, migraine, all of which have a certain relation to oversleeping. Stekel probably over-emphasizes this; but the subject should be investigated.

(10) The neurotics are always worrying for fear they will not sleep. Back of the question shall I sleep to-night, Stekel maintains, is concealed an anxiety in regard to sleeping and dreaming. Such people wish to separate rigorously the world of the conscious and the world of the unconscious. They grasp at the hypnotics, which deaden them, and the taking of drugs is the real beginning of severe pathological insomnia. The patient soon becomes a drug victim and the organism demands its daily narcotic. Anxiety is aroused lest one may not sleep without the hypnotic. The doses must be continually increased, so that finally a condition of toxaemia develops out of the sleeplessness. Formerly, according to Stekel, they were only the victims of morphine, but now there are people who take enormous doses of veranol, sulphanol, trianol, paraldehyde, etc.

Some people maintain that they do not sleep. There is, however, no such thing as absolute sleeplessness. (19) Patients come to a physician and say that they have not slept for three months. Others say they have not slept for half a year or more. This, however, is not true; and even those who give as proof the fact that they heard the clock strike every hour, really slept between the hours. The results of sleeplessness are over-estimated. Fear of insomnia is often only a mask and conceals really a fear of sleep. Many men are afraid of sleep. There are patients who go to sleep and then wake up as if they were hit by an electric shock. They dream that they are falling from a high mountain and the like. Of such nervous feelings many neurotics complain.

For such neuroses as Stekel describes apparently drastic remedies are necessary. Perhaps in many cases the best remedy would be the application of the general principle of mental hygiene for phobias. Make the individual do the thing

that he fears. In case of children and adolescents probably all that would be necessary would be to tell the patient to keep awake, assuring him that it would do no harm to lie awake in case one does not readily fall asleep. The attempt to lie awake is likely at least to remove the fear of insomnia.

Stekel, writing during the war, points to the fact that the war was the great enemy of sleep, as all classes were in a ocndition of undue excitement. The experiences of multitudes during the war illustrated the injury that comes from attentive sleep and the inability to control the excitement. Stekel has given interesting illustrations; and frequently, if not usually, after a time this attentive sleep results in insomnia.

Stekel tells the following story illustrating the tormenting sleeplessness from which many of the soldiers suffered; the case of a battery officer decorated with the highest insignia showing that in the first three months of the campaign he had taken part in 29 battles and lost only three men. He had no ground for fear and was never fearful. In spite of this he could not sleep for the whole three months. He always heard again the well known signals which warned him of an outbreak. He remembered in dreams commands that he had neglected; he dreamed, if he fell asleep, that he was in a battle and was about to fall over. Presently he woke again with his heart thumping, and he had to leave the front several weeks and go home in order to sleep regularly.

According to Stekel, it is a characteristic mark of the war neuroses and psychoses that all these patients, along with the great weakness and irritability and loss of will complain of sleeplessness. The insomnia is so obstinate that it defies the usual measures. Improvement comes with regulation of the sleep function. The patient begins to sleep first a few hours, then more, until finally the sleep amounts to five or six hours, which is an extraordinary result.

(11) One final precept, summing up what has been said, should be given. The last ten minutes before going to bed should be sacred to health and largely devoted to prevision of the physical needs of the night. In these few minutes one can determine largely the health character of one's reactions for the next eight hours. Then one should make good any physical need—lack of water, food, clothing, heat, cleanliness, or medicine. Purge the mind as well as the body of the poisonous products of the day's activity, worry, fear, any ill will, or grudge, or evil thought, and for once at least in the day make the attitude peaceful and healthful.

Conclusions

In view of the facts in regard to sleep, and from our general point of view, the following inferences seem justified.

(1) Sleep is an instinctive reaction to stimuli similar to the reaction of attention.

(2) The biologically adequate stimuli that produce sleep are primarily fatigue and darkness, and perhaps several physiological conditions. The associated or conditioned stimuli that tend to produce sleep are varied and may be anything whatever. Usually an environment free from the more violent stimuli is directly conducive to sleep.

(3) The reaction of sleep is one of inhibitory character, and this usually comes on gradually and becomes more intense and finally disappears gradually.

(4) The reaction of sleep, according to the recent investigations by Pavlov's students, is localized in the hemispheres of the brain and may be diffused from one part of the brain to another.

(5) The reaction of sleep may be partial or it may be complete. When it is partial certain conditioned reflexes are abolished and others are not abolished. In an early state motor conditioned reflexes may be present and the conditioned reflexes of secretion by certain glands may be absent; later the secretory reflex may be present and the motor reflex absent; and finally in complete sleep both motor and secretory conditioned reflexes are inhibited. In waking the conditioned reflexes reappear in reverse order.

(6) Sleep may be attentive or inattentive. In attentive sleep a portion of the brain seems to be partially awake; or, to put it as Sidis does, we are awake for certain stimuli.

(7) Sleep may be imaginal and associative or it may be imageless. The latter is dreamless sleep, the former of course is a condition of more or less orderly dreaming. While some maintain that dreamless sleep never occurs, there seems no satisfactory evidence for this assumption. On the contrary, since conditioned reflexes are abolished in animals, probably the power of association is inhibited.

(8) In imaginal or dreaming sleep the brain apparently, or a portion of it, is partly awake. The significant discovery by Pavlov's students that conditioned reflexes do not occur normally in sleep, suggests that here may be a clue to the fact that our dreams are so erratic. The abolition of the conditioned reflexes means that the cerebral cortex is not functioning normally, the association processes are not being carried on as in daily life. In our ordinary waking experience we always correct our thinking by constant reference to facts

and by other associations which have been developed from the facts of experience. In dream life this correction does not occur, and the fact that the associative processes of the cortex are not fully functioning gives us a plausible reason why this correction is not made.

(9) Various toxins produce sleepiness; and certain drugs produce a condition which superficially is similar to sleep, but really is probably very different.

(10) Sleeplessness is usually caused by intense stimulation, or conditions of excitement, which act as stimuli to waking reactions. According to Claparède, when waking activities are more interesting than the reaction of sleep, we instinctively keep awake. When sleep is the dominant momentary interest, we go to sleep.

(11) As Piéron says, modifying the teleological statement of Claparède, we sleep not because we are exhausted but before we are exhausted.

(12) Demonstrating that sleep is a phenomenon contingent to life, but not implied in the conception of life itself, the phylogenetic origin of sleep has been suggested as an inhibitory function of defense, which plays a great rôle in the struggle for existence among animals and men.

(13) Many related states, hypnosis, the hypnoidal state which precedes ordinary hypnosis, the hibernal sleep of animals, are for the most part to be explained from the same point of view, as instinctive reactions to certain stimuli.

(14) Whether we accept Claparède's theory or not, there is good evidence for at least considering sleep as coming under the general principle of stimulation and response. Both the experimental and the physiological evidence give good ground for this view. From this point of view the hygienic aspects of the subject are best seen.

The hygiene of sleep is that of instinctive reactions in general. There should be no repression, no artificial interference, no postponement, no perversion; in case of children no curtailment, no interference; and normal habits of sleep should be developed on the basis of the instinctive impulse. Interference with an instinctive reaction is always liable to be dangerous. Interference with sleep, by improper food, by drugs, by exciting activity, or worry, causes attentive sleep, insomnia, the fear of insomnia, or the like. Nothing perhaps would add more to the health and efficiency of people, in this country especially, than the practice of hygiene in regard to sleep; and the development of a scientific hygiene of sleep for children and adults would be one of the greatest contributions to somatic as well as mental hygiene.

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MALNUTRITION AND HEALTH EDUCATION

By David Mitchell and Harriet Forbes, Bureau of Educational Experiments, New York

Organization of Classes

The conclusion of our work last year led us to the decision that it would be wise both to carry on the work with some of the same children, and also to set up an entirely new experiment. To carry out the first purpose the principal of the school [1] arranged for two open air classes, of which the children should be, as far as possible, those who had been in our nutrition classes the previous year and who were still seven per cent or more underweight for their height. Altogether in these two open air classes 48 children of this type were included. The number of children with various percentages underweight are shown in Table I. The first column gives the distribution of percentages underweight from 21 to seven per cent. Columns two and three show the number of children in the two groups who were the various percentages underweight, while the final column gives the total number in the two classes. There were 13 children ranging from seven to nine per cent underweight; three of the 48 were from 19 to 21 per cent underweight for their height.

In arranging for the new experiment we selected the fifth grade children as the most desirable since they were about the

TABLE I

Distribution of Percentages Underweight at Class Entrance

Per cent	Open Air Group 1	Open Air Group 2	Total
—21 —19	1	2	3
—19 —17	2	..	2
—17 —15	3	..	3
—15 —13	6	4	10
—13 —11	3	3	6
—11 — 9	3	8	11
— 9 — 7	8	5	13
Total	26	22	48

[1] Public School 64, Manhattan, is for boys only and has an enrollment of over 3,000. Mr. Louis Marks is principal. See Ped. Sem., xxvi, 1919, pages 1-26.

TABLE II

DISTRIBUTION OF PERCENTAGES OVERWEIGHT AND UNDERWEIGHT

Percentages	Fifth Grade Classes 5A-X	5A-Y	Total
53 —51	1	..	1
.....	..	..	..
25 —23	1	..	1
23 —21	..	..	..
21 —19	..	..	..
19 —17	..	..	..
17 —15	..	1	1
15 —13	..	2	2
13 —11	2	4	6
11 — 9	6	1	7
9 — 7	7	..	7
7 — 5	8	2	10
5 — 3	3	4	7
3 — 1	9	6	15
1 — 1	16	11	27
— 1 — 3	13	6	19
— 3 — 5	19	4	23
— 5 — 7	12	7	19
— 7 — 9	21	10	31
— 9 —11	9	8	17
—11 —13	5	..	5
—13 —15	5	1	6
—15 —17	1	..	1
—17 —19	..	..	..
—19 —21	1	..	1
Total	139	67	206

same age as the majority of the other children, and also, up to the time of this measurement of them they had had no training through our nutrition classes. The children were organized in two groups in the school system. In one group there were 139 and in the other 67. The distribution of the percentages overweight and underweight is shown in Table II. They ranged from 53 per cent over- to 21 per cent underweight. In one group, 17 children are seven per cent or more overweight, 80 are within seven per cent of average, and 42 or 30 per cent are as much as seven per cent underweight.

Owing to the epidemic of influenza and necessary rearrangement in the school organization the classes of fifth grade children were not organized for approximately seven weeks after the initial weighing. At this time 39 of the 42 5A-X children were again weighed. The distribution of weight is shown in Table III. The second column gives the distribution at the first weighing. None of the children is less than seven per cent underweight. As shown in the third column, the children seven weeks later had increased so that they were markedly nearer the average weight. Twelve of the children were within five

to seven per cent underweight. Nine of them were from three to five per cent, while one had come up to within three per cent of average weight. A total of 22 children at this first class meeting would according to our accepted standards be considered as being above the "dead-line" of undernourishment.

Several reasons for this progress might be given. In the first place, regularity in school life, as contrasted with the irregularity and unsatisfactory conditions of city living during the summer time, might be advanced as a possible cause. On

TABLE III

PERCENTAGE UNDERWEIGHT AT FIRST WEIGHING AND FIRST CLASS MEETING

	Fifth Grade Group	
Percentages	1st Weighing	1st Class
1 — 3	..	1
3 — 5	..	9
5 — 7	..	12
7 — 9	19	8
9 —11	11	4
11 —13	4	1
13 —15	4	2
15 —17	..	1
17 —19	1	1
Total	39	39

the other hand, there is some reason to believe that this increase in weight was apparent rather than real. The first weighing of the children occurred in the latter part of September, a time of great heat with consequent light clothing. The second weighing occurred in November when the temperature had dropped considerably, and in some cases, if not in all, the children had commenced wearing heavier clothing. If the latter explanation is the true one, and it undoubtedly is a contributing factor, we are led to the consideration of the reliability of fine determinations. It is possible that increases or decreases in weight may be due to variations in the clothing rather than to the observance or neglect of prescribed conditions.

Physical Examinations. Each child in the class was given a physical examination, which was planned to cover such features as bore definitely on the nutrition of the child. In all cases which seemed to show naso-pharyngeal obstruction, the advice of a specialist was obtained. The open mouth, mucus discharge, granular throat, dull or retracted ear drums, and enlarged, buried or cryptic tonsils were indicators. Throughout the school year operations were performed in 23 of the 32 necessary cases.

Social Environment. The section in which the school stands is somewhat removed from the worst slums. In none of the 87 families visited has there been evidence of inflated incomes due to war industry. Rather has it been true that with the majority there was increased hardship due to loss of their wage earning members and to the increased cost of living.

School Environment. The children were housed in a modern building equipped with shops, baths, auditorium, and yard space, while a well conducted eye clinic which served the district under the Department of Health was given room in the building. The daily use of the nearby park and the social activities represented by the Boys' Club, the Settlement, and the Library, enriched the curriculum considerably. The school had stood for many years as one of the most progressive in the city.

Weekly Weighing and Interviews. At the time of the weekly weighing, there was an interview of five to ten minutes with each boy. Data were collected under the following heads: weight, rest periods, lunches, number of hours sleep the previous night, amount of food, coffee or tea, water at meals, windows open, lack of breakfast, rapid eating, excessive fatigue, colds, clothing, and any other significant facts.

Charting. Charting of the weekly gain or loss together with data such as the number of daily rest periods and lunches, the use of stimulants and the number of calories, was done prior to the class exercises.

Measured Feeding. A record of the kind and amount of food taken for forty-eight hours was kept weekly by each boy in a book in which there was a table showing 100 calorie portions of various foods. This table was a source of interest and most of the children chose to figure their own caloric intake and did so with considerable care and success. The use of this book made it possible to introduce gradual changes and increases in diet along the line of least resistance. Thus, by the addition of a few prunes, a pat of butter, an extra glass of milk, or a slice of bread, a child can easily obtain the amount of food required.

Class Periods. For the instruction the charts were arranged with the one showing greatest gain for the week placed first and the others following in regular order. The children took seats in the relative position of the charts. A half hour was then spent analyzing the records and taking up questions such as: what constiutes good nutrition, the uses of food, the significance of measured feeding, the value of certain foods, and food habits.

Home Visits. Because it proved too difficult to persuade the mothers to attend the class periods regularly as is done at the hospital nutrition clinic, it was necessary to increase the number of home visits considerably and miniature charts were carried into the home to be studied there.

Control Investigation. For two reasons we wished to study a group of normal children. In the first place, we could not tell whether the underweight of some of our children was temporary or chronic. By selecting a group of children who were approximately average weight for their height at the time of the first weighing, and by repeated measurement, we could determine the extent of the variability. In the second place, in order to check up on our psychological investigation of the undernourished child we must have similar data secured through experimentation with wellnourished children. Table IV shows the results for 35 children. The first column of this table indicates the percentage over- and underweight. The second column shows the distribution at the time of the first weighing, the second and third columns for two other weighings, at the beginning of the second school term, and in the final week of May. Unfortunately in this third weighing eight of the children could not be secured, so our results are for 27 instead of 35. The variability is quite marked. Whereas at the first weighing all of the children were within three per cent of average weight for their height, on the second weighing they varied from nine per cent under- to 12 per cent overweight, and on the final weighing the 27 children ranged from eight per cent underweight to five per cent overweight.

Results

In tabulating the results we have considered the gain as a percentage of the normal gain rather than a percentage of gain in excess of normal. The expected gain for any cihld is determined by taking the yearly increment for children of his age and finding a proportionate amount of increase for the period the child was in the class. Determinations were made for the first twelve weeks of the class, for the first nineteen weeks and the final weight which was for the open air class approximately thirty-two weeks, and for the fifth grade class approximately twenty-seven weeks. Besides this, there was calculated for the fifth grade class the percentage of gain for the seven weeks which elapsed between the original weighing and the first meeting of the class.

The results for both groups are shown in Chart 1. On the base line is indicated the periods for which results were calcu-

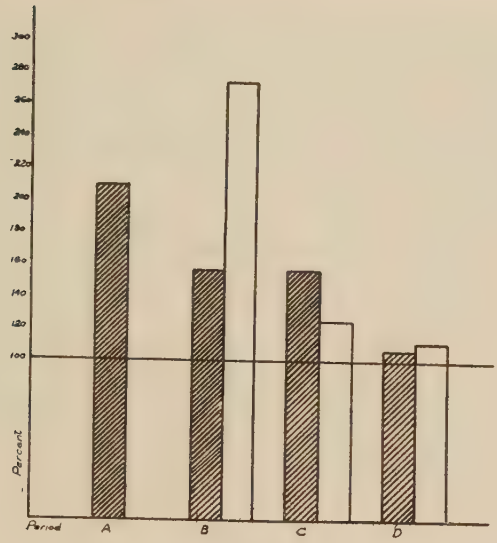

CHART I

TABLE IV

PERCENTAGES UNDERWEIGHT FOR THREE WEIGHINGS

Percentage	Control Group 1st Weighing	2nd Weighing	3rd Weighing
—9	..	1	..
—8	..	..	1
—7	..	..	1
—6	..	..	3
—5	..	1	1
—4	..	..	1
—3	7	3	..
—2	7	1	3
—1	4	3	3
0	6	5	6
1	4	4	..
2	3	3	4
3	4	3	2
4	..	1	1
5	..	2	1
6	..	4	..
7	..	1	..
8	..	1	..
9	..	1	..
10	..	..	..
11	..	..	..
12	..	1	..

lated; A, the first seven weeks for the fifth grade classes; B, the first twelve weeks of instruction; C, the nineteen week period; and D, the final result. The figures at the left hand side of the chart are percentages of normal gain. The height of the columns shows the average per cent of gain, the shaded column indicating the fifth grade group and the plain column the open air classes. The open air classes in the first twelve weeks increased 274 per cent of the normal gain, whereas in nineteen weeks it was 125 per cent, and in the entire period 111 per cent. The difference is not so great for the children of the fifth grade classes. In the first seven weeks between the original weighing and the first meeting of the class, the average percentage gain in relation to normal was 208. In the first twelve weeks of the classes it had decreased to 156 and was approximately the same for nineteen weeks, but for the entire period it was only 106 per cent. In other words, the effect is marked in the beginning of the work, but constantly decreases until the expected rate of gain is reached.

Chart 2 shows the percentage gain for the children of the

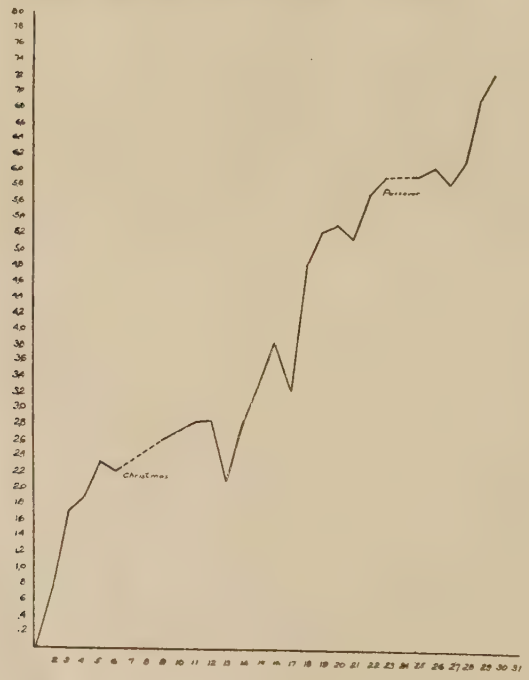

CHART II

fifth grade classes for each week. It is constructed so that the base line indicates weeks and the figures at the left show the percentage of gain on the original weight. The gain for the entire period is approximately nine per cent. If the gain had been calculated from the two weights given at the beginning and the end of the period, it would have been approximately ten per cent, but we wished to have the record of the weekly gains so that we might if possible show the relation of various school periods to the children's progress. At promotion time the children register a loss of approximately 0.6 per cent. The recovery, however, is fairly rapid, an almost equal gain being registered the week following. In the same way, for parade week when there was a special holiday, the children lost.

A Physical Handicap. The effect of enlarged tonsils and adenoids on the nutrition of a child has long been suspected. A good indication of it may be obtained by comparing progress in a period previous to correction and in a similar period following operation. Of the 23 children for whom operations were arranged, only ten are available for this comparison. The reason was that we wished to have a period of at least five weeks after the child had returned to his original weight, that is, when he had recovered from the loss consequent on the operation. The relation of the gain during the second period to the progress during the first period is graphically shown in Chart 3. In this chart the percentage of gain is shown on the ordinate. The position at which the children were at the beginning of the first five week period is shown by the zero point. The average loss of four-tenths of one per cent for five weeks before the operation is shown by the first section

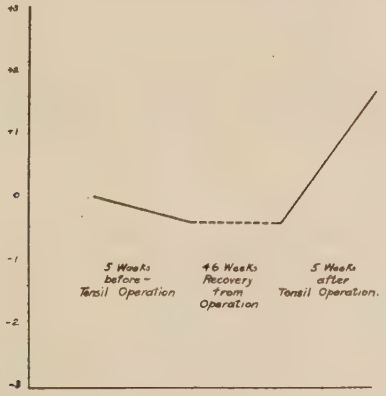

CHART III

of the curve. The elapsing of four and six-tenths weeks during which the children recovered the weight which they lost at the time of the operation, is shown by the dotted lines. The average gain for the five weeks following this recovery is shown in the third and final part of the curve. The rapid rise in this part of the curve is in sharp contrast to the direction in the first part.

Other Factors. We made investigations of the relation of caloric intake, the number of rest periods observed and the number of lunches taken, to the percentage of gain. In none of these cases did we find a clear cut correlation. Had our groups been much larger we might have been able to isolate one factor but with our small numbers it was impossible to make classifications in which only one factor was operative. In reference to these conditions we must wait for further evidence.

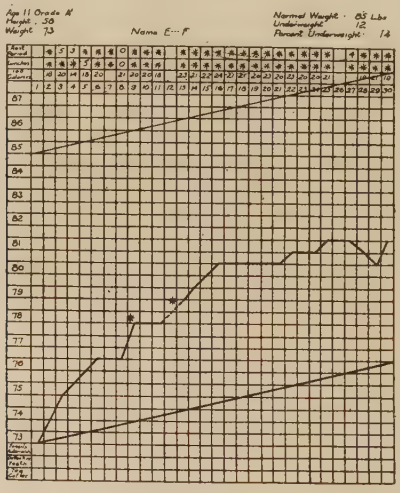

CHART IV

Individual Children. The record of Chart 4 is one where the evidence seems to be conclusive that the method of the nutrition classes is effective. The physical defects of this child had been to a large extent remedied before the beginning of this class period. His teeth were in good condition and enlarged tonsils had been removed before the beginning of this class. In other particulars his physical condition was fairly satisfactory. For postural defects a certain amount of correctional

gymnastics was prescribed. So satisfactory was this child in observing the requirements that he insisted on keeping a record of calories at vacation time. Backing up this co-operation on the part of the boy, was that of the home. His parents were in fairly good circumstances and intelligently assisted in all the efforts which the school put forth for the progress of the boy.

The record of Chart 5 is of possibly greater interest. The conditions with which we have to deal are apparently similar. In this case the physical defects were minor. An operation for the removal of tonsils had been performed about four

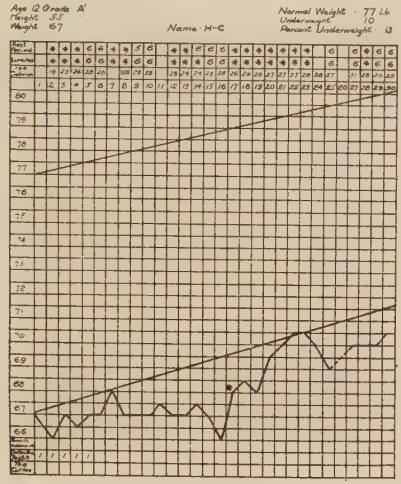

CHART V

months before the beginning of the class. At the time of the examination certain conditions were noted which may have been the remaining effects of this abnormal condition. The anterior cervical glands were enlarged, the throat was granular and the ear drums were dull. The mother reports that no great progress was noted even after the operation and the record which we here present corroborates her statement. The curve for his actual increase in weight runs almost parallel with the line for the expected increase. In co-operation he was not so satisfactory as the previous child, as the record of mid-morning lunches and rest periods indicates. One condition which he did fulfill was to slightly increase the amount of food taken. The caloric intake of the last week is slightly higher

than during the first part. This child shows very clearly the need for extensive investigations in the problems of nutrition. As a hypothesis, we may say that some children are biologically lighter in weight than other children of the same height. This child may be one of the extremes in that normal variation.

The record of Chart 6 is similar. At the time of the physical examination he had five carious teeth, four of which had been treated by the time of the class opening. Tonsils had been removed the previous year. The physician reported that the child was a mouth breather, that his throat was granular and

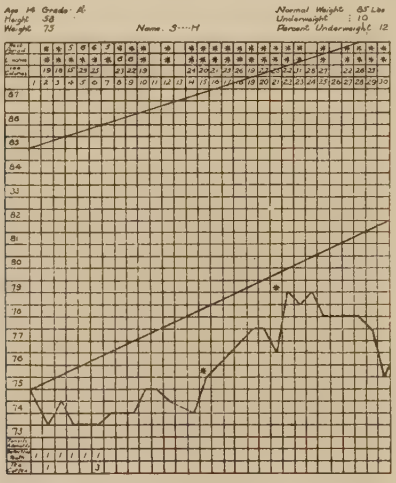

CHART VI

that the cervical glands were considerably enlarged; also that the ear drums were dull and retracted. At an examination toward the end of the nutrition class period, his throat was reported in satisfactory condition, the tonsils presenting no difficulty, but four other teeth needed treatment. His general health seems to have been fair, the only diseases which he had had were whooping cough at four years and measles at five years of age. His record for rest periods, lunches and caloric intake is fairly satisfactory. His caloric intake for the first three weeks was lower than expected but later the amount seems to have been sufficient. Co-operation from the mother was very poor, the investigator reporting that illness, indifference, and ignorance, were the chief characteristics of the family.

We have shown in the general discussion that the removal of enlarged or diseased tonsils was followed by a rapid increase in weight. Chart 7 shows one of the cases where there was a fairly good increase, even while the child suffered from this physical defect. Nevertheless, the gain in this case is more rapid in the first than in the later weeks. In the first two the child gained four pounds. He was then four and one-half pounds underweight. At the end of the class period, he was five pounds underweight. In other words, from the begin-

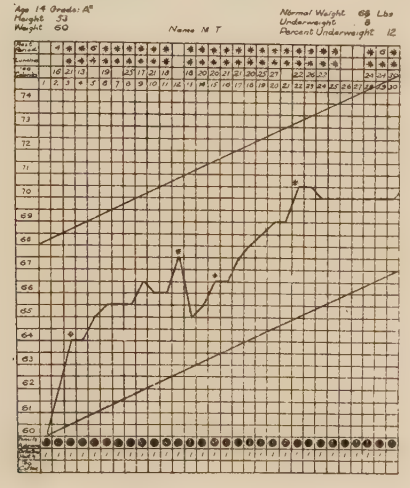

CHART VII

ning of the third week of the nutrition class to the end, the gain was less than the expected gain. It may be that the removal of the diseased tonsils would have remedied the condition and this child would have reached the average weight for his height. There are, however, certain other factors to be considered. The child's stepmother was not particularly co-operative and according to the social investigator would be described as "queer." It may be that her attitude toward the boy was a possible factor in the progress. The child himself co-operated fairly well. In only three cases out of the total number of weeks did he fail to observe all the requirements of rest periods and mid-morning lunches. The caloric intake increased with the continuance of the nutrition classes. In the first few weeks the amount ranged from 1300 to 2100 calories, in the last few weeks from 2200 to 3000.

In some ways the conditions shown in Chart 8 are identical with those of the previous one. The child suffered from diseased tonsils throughout the year. He increased somewhat the caloric intake, going up from 2200 to over 3000 calories. He got his mid-morning lunch every day of every week. Other conditions, however, are quite different. He lived in a good home where the co-operation was good, but they feared the result of having an operation performed for the removal of the diseased tonsils. His throat was reported granular, the

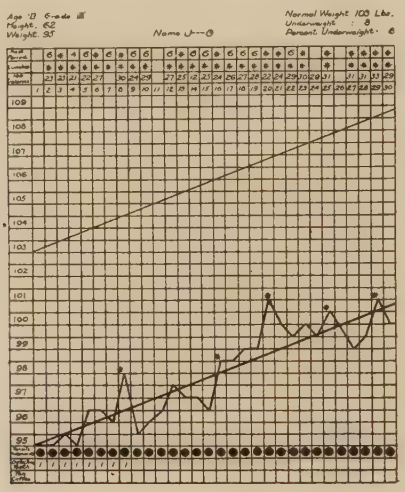

CHART VIII

cervical glands enlarged and the ear drums dull. He had certain postural defects such as round shoulders and winged scapulae. It may be that the diseased tonsils were responsible for this child's failure to gain. Obviously it is necessary before any other conclusion is reached to have this physical defect removed.

The child whose record is shown in Chart 9 is one of those for whom we succeeded in having an operation for enlarged tonsils during the class period. He is also one of those whose gain after the operation was very good. In the beginning he was eight per cent underweight. By the end of the period he had come up to within half a pound of being the average weight. In the family situation there were certain other conditions which militated against rapid progress. Emotional

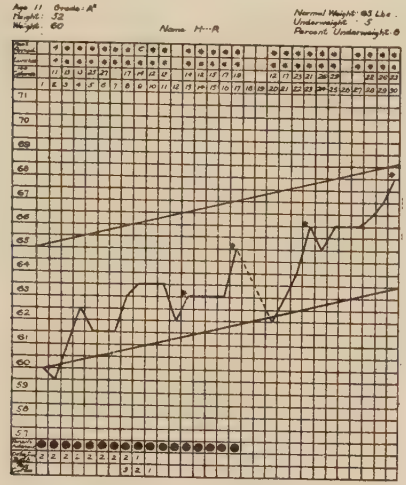

CHART IX

conditions, primarily antagonism on the part of other children because of favoritism to this child, seemed to play some part in determining the rate of progress.

Chart 10 gives the record of a child who was apparently in very bad condition at the time the class was organized. He

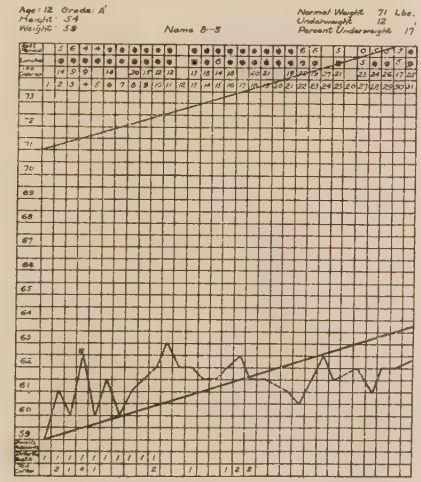

CHART X

was 17 per cent underweight. He had had an operation for diseased tonsils. The physical defects were insignificant, there being only one carious tooth. This child was, however, handicapped by the attitude of the family toward him. The investigator reports that he was "petted and spoiled." He was also one of the few children who succumbed to the temptation of tea or coffee. Nevertheless, these factors did not seem sufficient to explain his failure to make better progress. He has just failed to make the expected gain, being one pound more underweight at the end of the class period than he was at the beginning.

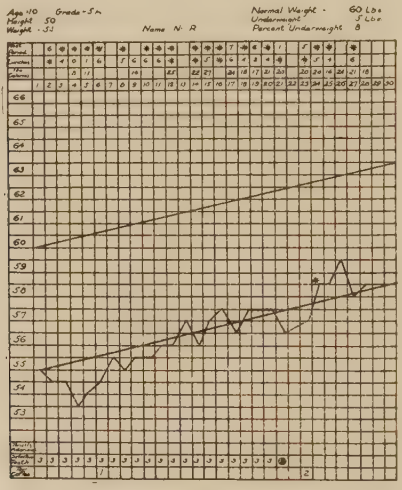

Chart XI

The child whose record is shown on Chart 11 presents serious difficulties. He has improved considerably, but he still shows symptoms of nervous instability. He is one of those children of whom it is suspected that there is a greatly increased basal metabolism. In other words, the amount of food necessary to counteract the waste due to the ordinary functions of living, such as respiration, heart action and so on, is very great. This child shows clearly the necessity of more information concerning the nutrition processes. His highly excitable and nervous condition may be a symptom or a cause. It is necessary that we understand some of the physiological and psychological processes before the diagnosis in this case is possible.

Philosophy of Nutrition Classes

At one time it was rather generally assumed that the fundamental cause of malnutrition was lack of sufficient food. Somewhat recently this notion has been considerably modified. Malnutrition is not unknown among children of the well-to-do, and in cases where children were receiving sufficient food there has been serious undernourishment. We have, therefore, been led to look for other causes than poverty.

It was with the consideration that undernourishment may be the result of ignorance and faulty education, that the Bureau of Educational Experiments was concerned when it planned to carry on the nutrition classes. As a tentative hypothesis we decided to assume that either the children had a sufficient amount of food or the necessary quantity could be procured. For the undernourished condition we might assume as a casual factor, ignorance, both on the part of the parent and child as to the desirable conditions under which food should be taken. From this point of view education is obviously a solution of the problem.

But this was not the only consideration urging us to set up an experiment in nutrition. First hand experience and opportunities for self-expression are as valuable in nutrition as in other fields. We believed that the approach to health education, where children had an oportunity to experiment and make original observations would inevitably lead to the most desirable results.

The instruction in our classes was concerned with what we may call certain positive or helpful conditions and certain negative or detrimental factors. The children were brought into the class room and there were displayed prominently before them charts of which those numbered four to eleven in this report are typical. The child who made the greatest gain for the week had his chart in what was recognized the head position in the line of charts. The other charts were arranged in the order of decreasing gain until at the opposite end of the line, the chart of the child who had made the least gain was placed.

The desirability of our class procedure must be seriously considered. We assume that a certain number of conditions were responsible for a child's failure to gain and that with the removal of these conditions, progress would be inevitable. Among the conditions which we considered detrimental were lack of sufficient rest, use of stimulants such as tea and coffee, failure to take time to properly masticate the food while one was in a restful position, the presence of carious teeth or diseased tonsils, and also excessive expenditure of energy in

violent exercises or overwork. When a child had made progress, one of these factors where he had lived up to our requirements was sometimes emphasized as the reason. We told him that he was doing well and he should continue in the way in which he had been going.

The fact that the children made progress at times when they did not fulfill conditions militated seriously against the acceptance of our judgment. At the same time we reported to the children that the failure on the part of others to make progress was due to their lack of observance of the conditions which we prescribed. We spoke about the failure of a child to gain for whom an operation had been recommended for the removal of enlarged or diseased tonsils, and we emphasized that condition as being the one which made his progress impossible. Nevertheless, the children were able to see from the charts that gains were not made only by children free from enlarged or diseased tonsils, but that some children, as for instance the child whose record is shown in Chart 6, made progress despite the handicap. We found also children who consistently failed to make more than the normal rate of progress and who as far as we were able to determine, more faithfully observed our conditions than other children whose progress was more rapid. Considering all these facts, it is evidently necessary for us to reconsider our hypothesis and procedure and to question the effect of our instructions on the child.

We shall consider first the revision of the hypothesis. Unfortunately our group of children is not large enough that we are able to classify them in such a way that we may get an indication of the effect of one isolated factor. The fact, however, that some of our children consistently failed to make more than normal progress, leads us to the question of a possible biological variation which may be a perfectly normal condition for them. It is obviously necessary in order to answer this question to consider the progress of such children over a long period of time when the conditions which we consider important may be constantly observed and when the general health of the child may be definitely known. If, as we suspect is possible, a child may continue markedly under the average weight for his height and still show no physical defects nor an insufficiency of energy for meeting all the demands which life makes on him, it seems necessary for us to conclude that this child's condition is normal, or in other words is certainly not diseased even though he be so greatly different from the average of his group.

The second question which we propounded to ourselves was concerning the effect of our class procedure and our discussion upon the children themselves. On the one hand we spoke about the result of observing certain conditions as shown in the child's gain, at the same time that another child who had observed those conditions, failed to gain. Taking for granted that the children have some ability at analysis and judgment, it is inevitable that their inference is that it is largely a matter of chance whether one makes progress and that the observance of these conditions then becomes a matter of preference;—they may or they may not gain. On the other hand we have children who are consistently failing to make progress greater than the expected rate and who are honestly endeavoring to do all that is required of them.

We hold up before them the record of a failure. The child sees his normal weight line shown far, far above his actual weight line and week after week goes by in which he sees no progress being made in decreasing the distance between the two lines. The psychology of success is as applicable here as it is in any other situation. The accomplishment of a purpose is a stimulus to a greater effort. Constant failure on the other hand leads to indifference and lack of effort. The psychology of failure is as significant as the psychology of success. Persistent failure develops lack of confidence and makes for the cessation of all effort.

We are therefore faced with the problem in our nutrition classes of deciding on causal factors. We must know the amount of food necessary not only to maintain life, but also to supply the energy which is used up in various life activities. We would also have to consider the effect of various physical defects and living conditions on the child's nutrition. Obviously it would be desirable to be free from all physical defects, but there are probably some which interfere but little ,if at all, with the nutritive processes. It is highly probable that diseased tonsils are detrimental in nutrition. It is extremely improbable that such physical defects as Darwinian tubercle or a supernumerary finger would have anything to do with nutrition. An evaluation, however, of the influence of physical defects is highly desirable.

Not by any means is the psychological aspect the least important one. This we may consider under two heads: (a) the attitude of the child toward food, and (b) the emotional characteristics of the children and their associates. It has been clearly shown that the former of these factors is highly important. People have thought they were starving because the type of food taken had been changed, even though the caloric

or nutrition value of the food taken was much greater than that of the food to which they were accustomed. In other words, one could "starve"[2] despite the fact that more nourishing food was provided.

These factors were not seriously considered in preparing a diet for our children and in many cases the only thought given in the preparation of a diet was to include certain forms of food which were deemed desirable or necessary in order to offer an all round food supply. It will be necessary in further experimentation to consider the psychological factors of prejudice and preference in order to be able to say definitely what the effect of more food is on the undernourished child.

In reference to the second fact, that of emotional conditions, it has been shown very clearly by experimentation that certain emotional factors, such as rage or fear, have a marked effect on nutrition processes. Cannon reports the cessation of the churning movements of the stomach when these feelings are aroused. These two emotions are dominant, but many other emotional characteristics such as irritation, jealousy, worry, envy and so on, are probably important even if not such great factors as either rage or fear. In order to answer this question we need extensive investigations of the influence of these conditions on digestion or the other nutritive processes.

Despite such conditions, we would strongly recommend the inauguration and the continuance of nutrition classes for health education. It may be that we are not able to solve the problem in this generation by this particular method, but certain results indicate the far-reaching effect of the procedure. The children who are thus being taught the desirability of regularity of habits and the necessity of eating proper food and the necessity of eliminating harmful stimulants, will undoubtedly influence the nutrition of the next generation. How well they will do this may be indicated by the following illustration: One of the boys in the class came to the instructor with the remark that he had been trying to persuade his mother that "an ounce of prevention is worth a pound of cure." The instructor did not get the significance of the comment at first and asked the boy what he had been trying to do. His reply was that he had been interested in the class work, he had been reading about nutrition and had come across this statement. He concluded, "I tried for two hours to show my mother what that meant, and at the end of the time she did not know a thing about it." If attempts at the education of

[2] See Baylis, The Physiology of Food.

parents are made in this way, what may we not hope for in the education of children? We may not cure malnutrition by education, but we can develop habits and methods of living which will have a decided influence for good with our next generation.

Mental Ability of Undernourished Children.[8]

Some experiments seem to demonstrate that the undernourished child is less fit mentally than other children. He has been supposed to be less able to make progress in school subjects and to be less alert in adapting himself to the requirements of new situations. In order to test the validity of these conclusions we decided to experiment with our nutrition class children.

Our work had two parts: (a) the study of the emotional characteristics, particularly as they were shown in the home situation so that we might see if certain emotional characteristics were associated, if not definitely causal factors, in undernourishment; (b) a careful measurement of mental and physical qualities so that we might know in what way and to what extent the children in the nutrition classes differed from wellnourished children.

In order to make an interpretation of our results possible, we decided to work with a "control" group. We, therefore, selected those children in the remaining portions of the fifth grade classes who were nearest the average weight for their height. We found thirty-five children whose variation was not greater than three per cent.

The tests were both individual and group and consisted of the following: *Individual* 1. Rapidity of Movement or Tapping, 2 Control of Movement or Steadiness, 3. Strength of Grip or Dynamometer, 4. Dearborn Reconstruction Form Board, 5. Knox Cubes, 6. Memory Span, 7. Free Association. *Group* 1. Trabue Completion, 2. Following Directions, 3. Cancellation.

The selection of these tests was determined by two considerations, first we wished to get a measure of the pupil's mental and physical endurance together with an indication of his ability to adapt himself to various situations, and second, we wished to have a group of tests in which it might be possible to get a second result after a period of approximately six months without the factor of practice or learning having too great an influence.

[8] The experimental work was carried on by Dr. B. J. Johnson, but she is not to be held responsible for any errors or the interpretation of results.

Rapidity of Movement. The apparatus used for this experiment was the "tapping board" described by Whipple in his manual of mental and physical tests.

The score used in tabluating the results of this test was the total number of taps for forty-five seconds. These were divided into three periods of fifteen seconds each. The time was limited to forty-five seconds because in comparing results of a longer record, the third fifteen-second period shows little variation from the fourth or fifth fifteen-second period.

The results are shown in Table VIII.

TABLE VIII

TAPPING

		Nutrition		Control	
		First Trial	Second Trial	First Trial	Second Trial
Right Hand	1st period	79.2	82.2	81.8	83.6
" "	3rd "	68.5	68.6	72.1	69.2
Left Hand	1st "	71.1	72.7	70.3	74.1
" "	3rd "	60.9	64.7	59.8	61.4

The nutrition group on the first trial made a score of 79.2 in the first period and 68.5 in the third period. The control group is slightly superior, but the decrease in the third period does not differ greatly for the two groups. In the same way for the left hand there is but little difference in the groups, and the decrease in efficiency in the third period is almost the same.

In the second trial both groups are slightly superior to the first trial in the first 15-second periods. There is not so much difference between the scores for the two groups, and their decrease in efficiency during the 45-second period is almost the same. The remaining figures in this table showing the results for the left hand are in every case less than those for the right hand in the corresponding trial, but do not show any significant features.

From the standpoint of rapidity of voluntary movement it cannot be said that the undernourished children are either better or worse than the so-called wellnourished children. In five out of the eight results, the control group gives a slightly better record whereas in three of the results the nutrition group is superior. The predominance of one group over the other is not sufficient to warrant any conclusion of superiority either in ordinary capacity, in resistance to fatigue or in rate of improvement.

Steadiness Test. The apparatus used was the Dunlap Model of the Steadiness Tester, the construction of which makes it

possible to have each hole in the same relative position to the subject's arm for each test. The scoring was done by taking the number of the hole in which the subject made more than 12 contacts. Since the holes were numbered from one to ten in the order of decreasing size, the poorer the result the smaller will be the score. In tabulating the results no account was taken of the number of contacts the child made on any particular hole until this number exceeded twelve.

Some variation is shown in the two groups; the control group having a considerably larger number of children making a score of four or less, with both right and left hand. The average scores, however, for the two groups do not differ much. For the nutrition group they are 5.0 and 3.6 for the right and left hand respectively, while for the control group they are 4.2 and 3.2.

In the second trial made at the end of the nutrition class period, the average scores are practically identical for the two groups. With the right hand the scores are 4.6 and 4.7 for the nutrition and control groups respectively, and for the left hand they are 3.5 and 3.6. These differences are shown in Table IX.

TABLE IX

STEADINESS

	Nutrition		Control	
	First Trial	Second Trial	First Trial	Second Trial
Right Hand	5.0	4.6	4.2	4.7
Left Hand	3.6	3.5	3.2	3.6

From these results one would say that the improvement of the control group during the period of the experiment was greater than that of the nutrition group. As an actual fact the nutrition group falls back slightly in the second trial. The scores for the right hand being 5.0 and 4.6 in the first and second trials respectively, while for the left hand they were 3.6 and 3.5. On the other hand the control group shows a slight difference going up from 4.2 to 4.7 for the right hand and 3.2 to 3.6 for the left hand. One is led to the tentative conclusion that the wellnourished children are capable of better progress than the undernourished. A serious obstacle to the acceptance of this conclusion lies in the wide variation shown by individual children. Some of those who made high scores in the first test, made very low scores in the second, while others who had made low scores in the first, increased considerably in the second.

One of the interesting features of this test is the number of children who make a score of zero. With the right hand in the first trial not one child fails entirely. With the left hand three of the nutrition group and six of the control group fail on the first hole. In the second trial two children of the nutrition group have fallen down so much that their score is zero for the right hand. With the left hand the number of children in the nutrition group making a score of zero is the same as in the first trial, but only half the number of children in the control group make a score of zero with the left hand.

Dynamometer Test. The improved form of the Smedley Dynamometer was used. Ten trials with each hand were recorded, a brief pause sufficient to read the scale being allowed between each trial.

The average results for each of the 10 trials for the first experiment with the right hand do not vary materially. In four out of the 10 trials the score for the nutrition group is lower than for the control group. In the ninth trial the score for the control group is very much better than that for the nutrition. The average scores, however, for all 10 trials are identical for the two groups. With the left hand the control group is, with one exception, better than the nutrition. The average score in this case is 15.2 for the nutrition group and 15.6 for the control. In the second experiment at the end of the nutrition class period, the control group shows a more marked superiority, but both groups give a record which is inferior to that of the first trial. For the right hand two curves showing the results are almost parallel, that for the nutrition group being always lower than the one for the control group. The scores in this trial are 15.2 and 15.8 for the nutrition and control groups respectively, while in the first trial each group had an average score of 16.8. The scores for the left hand show a smaller dropping off from that of the first trial, the averages being 14.4 and 14.8 as compared to 15.2 and 15.6.

For the right hand in the first experiment curves of distribution almost coincide. For the left hand there is less similarity. The average scores do not differ much, but the difference in distribution is quite marked. In the second experiment average scores have a similar relationship but the distribution with the right hand is from 11 to 24 with the majority of the nutrition group ranging from 13-16, whereas in the control group the majority lies between 14.18. With the left hand the range is greater, but central tendencies are more clearly defined.

Fatigue effects may be seen by comparing the average of the first five trials with that of the last five. For the control

group in the first experiment these are 17.3 and 16.2 respectively, while for the nutrition group they are 17.6 and 15.9 with the right hand. For the first five trials with the left hand the scores are 16.1 and 16.5 for the nutrition and control groups respectively, and for the second five trials 14.3 and 14.8. In the second experiment there is a greater divergence in the two groups, but the average scores are not so markedly different. For the nutrition group for the first five trials and the second five trials the average scores are 15.8 and 14.6, while for the control group they are 16.3 and 15.2. With the left hand the scores are 14.9 and 13.8 for the nutrition group and 15.4 and 14.2 for the control group.

TABLE X

DYNAMOMETER

	Nutrition		Control	
	First Experiment	Second Experiment	First Experiment	Second Experiment
Right Hand	16.8	15.2	16.8	15.8
Left Hand	15.2	14.4	15.6	14.8
Right Hand 1st 5 trials	17.6	15.8	17.3	16.3
Right Hand 2nd 5 trials	15.9	14.6	16.2	15.2
Left Hand 1st 5 trials	16.1	14.9	16.5	15.4
Left Hand 2nd 5 trials	14.3	13.8	14.8	14.2

These numbers are collected in Table X so that a direct comparison is possible. In the 12 results given, for the two groups they are equal once. In only one case does the nutrition group give a result superior to that of the control. In ten cases the control gives the better record. From this it seems possible to conclude that as far as the qualities and capacities tested here are concerned the control group is superior.

The number of times in which the result for the second experiment is poorer than for the first is exactly 12. An explanation for this condition is highly desirable. We have considered the possibility of the child's attitude, but have found no satisfactory answer. In every case the children seemed interested and anxious to exert the maximal effort. There was no evidence of indifference or fatigue. They were as anxious to make a good record in the second experiment as they had been in the first.

The influence of the attitude of the examiner has also been considered. It may be that we assume that the child understands the necessity for doing his best as a result of the instructions given in the first experiment. This does not seem a satisfactory explanation, but until we are more familiar with

the effect of attitude upon a performance, it is not possible to entirely eliminate this hypothesis. The effect of a greeting, an expression or an intonation must be considered before we can evaluate the effect of the experimenter's attitude.

Dearborn Reconstruction Tests. The form board in this experiment was described by Dearborn, Anderson and Christianson in the Journal of Educational Psychology for October, 1916. The score used is the time required to complete the performance, 360 seconds being the maximum allowed. In the first experiment 12 of the nutrition group and eight of the control group failed. The distribution of the remaining children shows wide variation ranging from periods less than 60 seconds to periods over 330 seconds, with the children almost equally distributed in the various periods. The average time for the two groups, eliminating the children who failed, was 139 seconds for the nutrition and 144 seconds for the control group.

Some improvement is shown in the results for the second experiment, in so far as the number of failures is concerned. Seven in each group failed on this second attempt. The distribution shows a more marked central tendency, the curves approximating normal distributions. The average time for both groups is greater than in the former experiment, being 163 seconds and 153 seconds for nutrition and control classes respectively. No decision can be reached concerning the relative merits of the two groups since the average scores differ so little and the number of failures does not indicate any marked difference.

Knox Cubes. The procedure for this experiment was that recommended by Pintner and Patterson. The results for the two groups are nearly alike although for the second experiment the nutrition class has a very large number of children making the same score. In the first experiment the average score for the two groups is 7.4 and 7.8, the control group being superior. In the second, the control group is again superior; the scores being 6.4 and 6.8. Besides the greater number of children in the nutrition class who make the same score in the second trial, certain other variations are noted. The distribution extends over a wider range of scores, three of the children in the two groups for the second trial making a lower score than that made by any child in the first. On the other hand, one child makes a score of 11 and none had made a score higher than 10 on the first. As far as the standing of the two groups is concerned the children of the control class seem slightly superior.

Memory Span. The material for this test were series of digits, two trials being allowed for each series of from four to ten numbers. The memory span was the longest series on which a child succeeded on one of the two trials given, and previous to which he had not failed on both trials of any series. The nutrition group is slightly superior in the first experiment, the average score being 6.5, while that of the control group was 5.9. In the second, they are much more nearly alike, the score of the nutrition group decreasing to 6.3, while that of the control group increased to 6.2. The results indicate a slight superiority of the nutrition class children.

Free Association. The stimulus words were selected for the Association Test with the purpose of bringing out instinctive tendencies and general environmental influences. Words that had been used by other experimenters thus offering some standard of comparison, were given the preference. The lists used contained 49 words of which 14 are found in the Kent-Rosanoff list, two in the Woodrow & Lowell additions to this list and six in Jung's list of 100 words. Exact responses were recorded. In case the subject said, "I don't know," failure was recorded.

Tabulations made in this test include the frequency of response, the number of rhyming words, the number of meaningless words, the number of repetitions of stimuli, the time for the reaction to the different words, the time of the reaction for the five longest delayed responses, the number of individual responses and the average time of reaction per child. With our limited number of cases it turned out that no conclusion could be derived from most of these tabulations. The scattering of responses and various other factors made many of them of little value.

The average reaction time shows a decided difference in the two groups. The time for the nutrition children is considerably shorter than for the control group, being 2.7 as compared with 3.2 seconds. For the second experiment, the general results are not so dissimilar, but the relation of the two groups as far as the average time is concerned, is almost identical. For the nutrition group the average time is 2.5 seconds, while for the control group, it is 3.0 seconds.

Certain progress is shown in these results. The children are keener and more ready for response at the time of the second experiment than they were at the first. The difference being only 0.2 seconds on the average, we are not justified in considering it of great value. Less than a 10 per cent decrease in time, considering the number of children, is not of great significance.

Trabue Completion Scales. Scales B and D, which are described by the author in the publication entitled, "Completion Test Language Scales," were used for this experiment

In the first experiment the children do not show a very great difference, although one child in the control group scores zero and another child makes a score of only three. With this exception the distributions do not diverge materially. The average score for the control group is greatly influenced by the score made by the two exceptional children: it is only 8.8, whereas the average for the nutrition class is 9.1.

In the second experiment the divergence is considerably greater. In this case no child makes a score of less than six, but the number of the control group making the smaller scores is greater than the number in the nutrition class. The difference is shown in the average score which for the control group is only 8.9, while for the nutrition class, it is 11.0.

Since the results for the nutrition class are superior in both instances, it would seem justifiable to conclude that these undernourished children have made better progress in their school work and have more intelligence than the wellnourished children. The fact that the improvement of the nutrition children is greater than that of the control class might indicate that their intelligence is better, that they profit more by school training and have derived greater benefit from the year's work.

Following Directions. The material was devised for this particular purpose, some of it being modifications of earlier Directions tests. Using an "all or none" method of scoring, the results for the first experiment show variability in performance, the record for the nutrition group being slightly better than that for the control class. The superiority is also shown in the average score, which is 3.5 for the former and 2.9 for the latter.

By the time the class period was over, the nutrition children apparently had made no progress, their average score being identical with that of the former experiment. The children in the control group had made material progress, the average score increasing to 3.7.

Judging from the results in the first experiment, the undernourished children are better, but during the year they make no progress, whereas the children in the control group make such progress that they excel those of the nutrition class. From these conditions it is impossible to make any conclusions as to the superiority of one or the other group.

Cancellation: The material for this test was also devised for use in this experiment. There were ten questions, the

words of which were arranged in an irregular way, so that the subject had to rearrange them in order to form a question. He was then requested to check the correct answer in terms of yes or no. The number of questions correctly answered, omissions being counted as errors, was used as the score. According to these results, the nutrition group is superior, the average score being 7.4, while for the control group it is only 6.1. The superiority shows itself, also in the second experiment, although the distributions are not so clearly different. It is shown in the average scores, which are 6.5 for the nutrition group and only 5.8 for the control group.

The lower score in the second experiment is again a prominent feature. The nutrition class maintains its superiority, but has decreased somewhat more than the control group. It remains, however, at a higher point of efficiency than was reached by the control group in the first experiment.

The numerical results for the last seven tests are collected in Table XI.

TABLE XI

	Nutrition		Control	
	First Trial	Second Trial	First Trial	Second Trial
Dearborn Reconstruction	139	163	144	153
Knox Cubes	7.4	6.4	7.8	6.8
Memory Span	6.5	6.3	5.9	6.2
Association	2.7	2.5	3.2	3.0
Trabue Completion	9.1	11.0	8.8	8.9
Directions	3.5	3.5	2.9	3.7
Cancellation	7.4	6.5	6.1	5.8

From these results it seems impossible to conclude that there is a marked difference between the two groups. We cannot say that undernourished children are as capable as better nourished children, neither can we affirm the reverse.

One of the conditions which we must remember in drawing conclusions from these results is the condition of the children included in the two groups. We must remember that 39 children who were in the nutrition class group had made great progress by the time the first nutrition classes were held, at which time the psychological testing began. We have at the same time to remember that the children of the control group, who at the beginning of the experiment were within three per cent of the average weight for their height, varied considerably before the expiration of the year.

In going over the individual records we find that the children who were most undernourished as determined by the height-weight index have made among the best records for both groups.

In formulating the program and deciding on the series of tests to use we aimed to secure a measure of the relative improvement of the two groups of children and also to have a group of tests where practice with that particular test would be a negligible factor.

It would seem that if we had fulfilled our conditions there should be a slight increase in the performance ability of the pupils, which would be in some way a measure of the improvement expected during a period of six months.

The contradictory results in a number of these cases lead us to serious considerations concerning the factors determining them. A number of these might be mentioned. We have first the attitude of the children in working with approximately the same material which they had tried six months before. It does not seem that this is a valid hypothesis since the experience of many investigators has been that the interest of the children in these performance tests is not decreased on a second attempt. They come to the performance with as keen an interest in the experiment as they had at the first time.

A second hypothesis to account for these results would be that our tests are not of equivalent value. It does not seem possible to accept this hypothesis because of the fact that in many cases the material is identical and in other cases the two sets of material have been given to similar groups of children and have given almost identical results.

Another hypothetical explanation is that the unconscious attitude of the examiner influences the child's performance. Having gone over the experiment once with the child, one might think that the problem had been presented in exactly the same way. The influence of the past experience, however, may dominate to such an extent that unconsciously one fails to inspire the same enthusiasm or generate the same energy as in the first experiment. Before accepting this hypothesis, it will be necessary to investigate at length the effectiveness of an examiner's attitude on the emotional drive which determines a child's performance. It will be necessary to know the effect of an intonation or a facial expression.

A final hypothesis might be that these children had less vitality owing to the effects of the year's school work. This would argue that the strain of the school work was too great for any of the children of the school. It would not simply mean that the strain was too great for the undernourished child, but it would also mean that it was too great for the normal average-weight child, since the children of the control group show a result quite similar to that obtained from the nutrition class children. If such an hypothesis is open to consideration it is

obviously necessary to study our children more closely. A school procedure should be devised which would permit a healthy progress so that at the end of the school period the child may go on to other activities, well equipped physically for the strains which will be placed upon him.

One fact stands out clearly. It is that we are in approximately the same condition in respect to the problem of the mental development of undernourished children as we are in considering the causal factors in undernourishment. A frank confession of ignorance is all that we are able to to make. We do not know why many children fail to gain in weight, neither do we know that between the failure to gain in weight and school progress is there any clear cut connection. It may be that biological variations shown in decreased weight may be compensated for by greater ability and adaptation, i. e., by greater readiness of response to the stimuli of new situations. An answer to these questions will require much more extended and at the same time intensive investigation.

Emotional Characteristics

In formulating a study of these children it seemed desirable to consider emotional characteristics and habit reactions. We did not plan to formulate a routine experimental technique from the results of which conclusions might be drawn. What we planned to do was to study the child in the environment of the class room, of the street, and of his home. Unfortunately the carrying out of this plan was seriously interfered with by rearrangements in our own program. It was impossible to observe much that we had hoped to observe as to these particulars.

Certain characteristics indicative of the neurotic instability were noted in a number of children and the proportion in the nutrition class who showed these characteristics was slightly greater than in the control class. The difference was not sufficient to enable us to draw any conclusion as to the specific effects of this neurotic instability on nutritional processes. On the other hand, in our discussion of the child whose record was shown in Chart 11, we spoke of a neurotic instability in which one of the chief characteristics seemed to be an increased basal metabolism. This means that for the carrying on of the simple automatic functions of living a greater supply of nourishment is necessary.

Not only is the digestion of a certain amount of food necessary for proper nourishment, but there is also a necessity for it being taken under proper conditions, with desirable emotional attitudes and in certain ways. It has been shown that

disturbances in the emotional life of animals resulted in a disturbance of certain nutritional processes. In making a comparative study of these two groups of children it would be necessary to carry on a considerably more intensive investigation than has so far been possible. We found certain conditions which seemed to bear out the general hypothesis that an emotional disturbance is a causal factor in undernourishment. We do not mean to say that the emotional disturbance actually changed the processes which are necessary for satisfactory digestion. It may only be that the emotional disturbance results in a failure of desire to take sufficient nourishment. With the lack of sufficient nourishment, a decrease in weight would almost necessarily result.

The promotion period in the school gave considerable information concerning these factors. At that time the children in the classes showed an actual loss in weight, while both previous to and following the promotion period a marked increase was recorded. This loss in weight might be due to excessive expenditure of energy during that period, but it is quite possible and indeed probable, that it was due to the worry or other emotional disturbance which influenced the child's desire to take food.

Frankness on the part of our children as well as on the part of parents would enable us to make a much more satisfactory study of the influence of these factors. The desire to conceal quarrels or antagonisms has been pretty thoroughly drilled into all of us, especially when these antagonisms are between members of one family. It has been left to the insight of the social investigator to determine how far there was sympathetic co-operation among the members of the family group. In many cases there was co-operation, but it was not necessarily the type which involves an understanding of the child by the parents or of the parents by the child. The parents were usually willing to furnish food of the right kind and at the right time. They were also willing to make rearrangements in the living conditions and to take what steps were necessary to improve the child's physical condition. They were, however, not quite so alert to the importance of maintaining a happy and tranquil disposition. Continual fault-finding or criticism may arouse in the child an antagonism which would militate against a desirable progress. While it is impossible to present statistical information of the effect of this attitude, it seems certain that in a number of our cases, such an attitude prevented the effects of the nutrition class instructions being as marked as they might otherwise have been.

ALIAS HYGIENE[1]

T. A. Storey, Executive Secretary Interdepartmental Social Hygiene Board, Washington, D. C.

Hygiene "is an ancient art. Some of its most important precepts formed a part of the wisdom of the Egyptians . . ." thirty-five hundred years ago. Hippocrates wrote a "treatise on airs, waters, and places" over twenty-three hundred years ago and recorded in perpetuity certain valuable information that was even then a thousand years old. Over seven hundred years ago the Code of Health from the School of Salernum (1200 A. D.) assembled many facts on hygiene that are in harmony with modern scientific information. The Code passed through more than 200 editions and "For over two hundred years it appears to have been the most popular book in existence."

Since Hygia, the Goddess of the preservation of health, was worshipped in the temples of her husband or father, Aesculapius, in that wonderful era of hellenic civilization which the later modern world has failed in so many respects to surpass or even equal, there has come into the affairs of mankind an increasingly large number of discoveries and applications that relate to hygiene. One might say that Hygia has now so many children that she does not know them all or that the religion of Hygia has broken up into many sects that know each other not. For today the world has many arts and sciences that have an unrecognized or unappreciated relationship with hygiene. The multiplication of the sub-divisions of hygiene with their scientific bases, their dramatic importances and their far-reaching influences on the economic and social life of the people has obscured the great conception of antiquity. Today the average individual thinks of hygiene as a matter of cleaning his fingernails, washing his face or shampooing his scalp. Such health achieving and health preserving enterprises as eugenics, prenatal care, care of the baby, child hygiene, medical inspection, play, athletics, physical training, safety-first, medicine, surgery, dentistry, nursing, the feeding of an army and the recreation of a camp are not ordinarily recognized as aliases of hygiene.

[1] Presented before the American Child Hygiene Association, Section on School Age and Adolescence, Asheville, N. C., November 11, 1919.

Hygiene is the science and the art of the preservation of health. The sciences of hygiene are those sources of information from which we secure accurate data as to the agents that injure health, the contributory causes of poor health, the carriers of disease, the defenses of health and the producers of health.

The arts of Hygiene are concerned with the applications of the sciences of hygiene to the health needs of the individual, to the health needs of groups of interdependent individuals and to the health needs of associations of interdependent groups.

I need cite only a few examples to recall to you convincingly the ramifications of the scientific sources, and the practical applications of hygiene.

Between 35,000 and 75,000 persons lose their lives every year because of accidents. These accidental deaths are largely due to mechanical, physical or chemical causes. The mechanial, physical and chemical injuries of war are still fresh in our memories. Hygiene must include a consideration of the mechanical, physical and chemical agents that injure health.

The pathogenicity of certain bacterial, certain protozoan and certain higher animal parasites has opened a large field for a great variety of scientific investigations relative to the living agents that injure health.

The history of the Jukes and of the Kallikack families establishes heredity as a very important division of hygiene.

The relation of physiology to hygiene is obvious. As a matter of fact normal health is a product of normal physiology and abnormal health is a product of disturbed physiology.

The fact that there are approximately 75,000 deaths from cancer annually in this country and that there were over 6,000,000 deaths from influenza last Fall in all countries and the fact that we know very little about the cause or the transmission of either of these diseases indicates that there are important fields of scientific research in hygiene that are as yet undeveloped and perhaps as yet not even identified.

The influence of the economic and social status upon health is obvious. Money can buy a certain amount of health. The individual, the family and the community that has resource and uses it wisely can buy protection from disease and can provide for effective constructive hygiene.

Our rather recently acquired knowledge of disease carriers —insects, animals and humans—has added some tremendously important scientific information to general hygiene and opened up great fields for research. I need only remind you of such insects as the mosquito, the flea, the fly and the body louse

and you will immediately recall their relationship to disease. Only the most painstaking and varied entomological investigations have made it possible for us to understand the part these carriers play in the dissemination of disease and have made it possible for us to develop defenses against them.

Along with our greatly increased information concerning the scientific, economic and sociologic facts of hygiene, there has come also a much larger variety of conditions for the applications of those facts for the acquisition, conservation and defense of human health.

While our expertly qualified agencies are searching for further truth from the sciences of general hygiene, other agencies are engaged in distributing the information that we already have for the better information and education of our people.

We have agencies that are working to reach the individual in order to educate and inform him concerning protective hygiene, preventive hygiene, remedial hygiene and constructive hygiene.

Other agencies are engaged with the group for the purpose of informing and educating the home group, the school group, the occupation group, and the great public institutional group. And still other agencies are concerned with intergroup hygiene in the rural community, the village, the city, the county, the state and the nation.

This organization, The American Child Hygiene Association, contacts all these phases of hygiene. It must be concerned with the acquisition of a greater amount and more accurate information concerning the agents that injure health, contributory causes of poor health, carriers of disease, the defenses of health, and the producers of health.

It must be concerned with the education and information of the individual. It must be concerned with the hygiene of the home, the school, the factory and the institution. It must be concerned with the hygiene of the rural, city, state and national communities. It seems to me self-evident that our greatest progress in health will come when the interrelations of the thousand and one agencies in hygiene are recognized and brought into an active team cooperation. This section on School Age and Adolescence has much in its field that is intimately in common with the organizations that are concerned with mental hygiene, eugenics, prenatal care, the hygiene of childbirth, the hygiene of infancy, provisions for play and recreation, medical inspection, physical training, athletics, school hygiene, domestic, family or home hygiene, industrial

or occupational hygiene, institutional hygiene, rural hygiene, city hygiene, state hygiene and national hygiene.

Thirteen states have enacted laws, more or less satisfactory, on physical training for their public schools. The work of this section is essentially the same as that covered by a modern program in physical training. There is a national agency in the field that is concerned with influencing other states to enact laws requiring physical training in the schools. The object of that organization and the object of this organization are identical.

There is a powerful campaign on now for the suppression of prostitution. I saw a record the other day of a little girl, who, at the age of 13 years, had spent two years of her life as a commercial prostitute. There are states in this country in which the age of consent is as low as 14 years. These are problems of School Age and Adolescence.

We have a national organization that is engaged in improving the instruction of teachers, another one that is concerned with better training of teachers of physical education. Both of them need all the support you can give them—and you need all the success they can achieve.

We have various governmental agencies that under different names are concerned with hygiene; one of those agencies, The United States Interdepartmental Social Hygiene Board, is organizing and applying its governmentally derived powers for the vigorous and co-operative emphasis of the tremendously important fact that hygiene, in its composite structure—with all its aliases—carries a resource in health information, health education, health defense, health conservation, and health acquisition that is competent to increase enormously man power and woman power, the most precious assets of a nation.

It would be easy to multiply references to good players that should be on a powerful, and as yet unorganized, national hygiene team; if it were possible to organize the plays, formulate the signals and perfect the team, there could be no such thing as defeat.

NUMBERS, TIME AND SPACE IN THE FIRST FIVE YEARS OF A CHILD'S LIFE

By Sophie Ravitch Altshiller Court

Introduction

Are children below school age interested in counting, measuring, computation, etc.? If so, when does the interest begin? How does the conception of time and space develop? What stimulates these interests and this development, and which are the factors that are unfavorable?

The following is an account of the development of one child's conceptions of numbers, space and time from the age of twenty months up to the age of five years.

The child in question, A., is a boy and an only child. This latter circumstance gave him many lonely moments, but much fewer than would be expected. In order to meet his need for companionship, playmates have been encouraged to come to his house since he was two years old, and he was often allowed to go to them; he has had much out-door free play with neighbor children, and, beginning with the age of three years and four months, he was always a member of one kindergarten group or another, organized for him by his mother.

He was born and always lived in University communities, and the surroundings were those of a small town, encouraging quiet contemplation, concentration of thought and close observation.

His health has been perfect, except for a severe illness at the age of four and a half, after which he recovered remarkably well and regained his former vigor much sooner than would have been expected.

A. is lively and active, but never boisterous or daring, and never delighted in strenuous physical exercise. He is cautious and undertakes only what he knows he can do well.

This latter feature may indicate a mathematical mind, the more so, that from babyhood he seems to have been a lover of exactness.

But he also shows unmistakable linguistic abilities: he speaks almost perfect English, eagerly and easily learning new words and expressions. Since the age of two and a half he has had a remarkably rich vocabulary and seems to have an instinctive appreciation of grammatical forms. At the age

of three years and five months he became spontaneously interested in word-study of his own, and at the same time discovered the division of words into syllables and showed some notion of separate sounds incorporated into words. Since then he has always been interested in analyzing words into syllables and into sounds, and other phonetic "games." He has a splendid memory and memorizes verses—even long ones—from only hearing them a few times; at the age of three and a half he was able to recite three pages of rather difficult prose after having heard it several times. He has had an opportunity to hear several foreign words, and at once made them his own, with a fairly good pronunciation.

He may have inherited both—mathematical and linguistic abilities. His father is a mathematician and also knows several languages well. His mother is a linguist.

A. is quite a thinker for his age; the questions he asks really interest him, and he insists on being answered satisfactorily, listens to the answer attentively, remembers and discusses it. His insistent questions often embarass his parents, and more than once have compelled them to explain to him things, which they never expected to discuss with him until the age of eight or ten. Thus, I was obliged to tell him about the shape of the earth when he was four years nine months old.

Therefore, though he seems to have mathematical abilities, they are not sufficiently pronounced to classify him as a "mathematical mind." He may be rather put into the class of "bright children," of which there are recently so many, especially in families of intellectuals. At the age of three years four months he was given the Binet test and showed the intelligence of a child of four years eight months, an IQ of 135.

Probably, a very important factor in A.'s development is his mother's pedagogical experience.

His mother is a teacher by profession and by inclination. She has taught both individual students and large classes, and has at different times had pupils of both sexes and all ages, from kindergarten children up to college classes and grown-up illiterates. Her main experience has been in teaching languages.

Ever since he began to talk, A. showed immense interest in numbers, later in measuring both time and space. He always delighted in counting, and whenever there was any danger of his becoming impatient with the process of combing his curls, or dressing him, he would be kept quiet by either a story, or a verse, or "counting."

As soon as his interest in numbers became apparent, much attention was given to his efforts in this direction, and help,

when asked for directly, or when the need of it was evident, came forth abundantly and willingly. Often his attention was called to the numbers of blocks picked out for construction, to the number of plates at dinner, etc. But he was never forced to count, and every new step in his arithmetical development was undertaken by him without any outside stimulus.

Thus, though encouragement was never lacking, whatever A. learned in regard to numbers, space and time measurement, was practically self-taught. Up to the age of four years eight months he never had any lessons in arithmetic. In the four successive kindergarten groups (Fall 1917, Winter 1918, Fall 1918, Winter 1919—ages three years four months to four years ten and a half months) the main parts of the program were manual training, games, music, stories, and nature study; whatever number work there was, was below his level.

I. The Growth of A.'s Notion of Numbers

A. *Up to the Age of Two*

A. began his intimacy with numbers by using "two" before he ever used "one."

At the age of twenty months he used to point out objects, name them, then immediately look around for their mates, and shout out with glee: "two;" "lamp—two lamps!"; "train —two trains!". At that time he ignored anything beyond "two" altogether.

At first his "two" appeared separately, without the noun. When we would say to him: "see, a flower!"—he would find another one, and say "two." It may have meant "too" then. But within a few days he began to add the noun, in plural form.

It is necessary to remark here, that we have never taught him to speak, i. e., never made him repeat words after us.

B. *His Third Year*

I do not know precisely, when "one" appeared for the first time. But at the age of two years he used "one" and "two." "Two" then meant anything above "one." Thus, when seeing shoes in a show-window, he exclaimed: "two shoes!"

At the age of two years eight months he could count from one to ten (merely naming numbers in their successive order). Nobody taught him this in the sense of forcing his attention or making him repeat it. But we amused him often with nursery rhymes and finger plays, among which were also those with numbers, and he learned the successive order of the first ten numbers from hearing it only.

At the same time (age two years eight months), if shown some beads, marbles, spoons, blocks, or anything else, and asked "how many?" he would answer correctly only "one" and "two." Any number beyond two was "many."

A month later he showed familiarity with "three," recognizing three objects at a glance. "Many" became relegated to the region beyond three.

C. *His Fourth Year*

At three years A. counted (named numbers in their successive order) to twelve, sometimes skipping ten.

He knew one, two, three, four, i. e., could recognize four small objects at a glance, understood which number (within four) is "more" and which is "less," and knew that if you have two and want four, you must get some more, while if you have four and want three, you must take away one.

He could then count objects within six.

He liked to count and to talk about numbers, but never was shown figures as yet—not until the age of four.

Beginning with the age of three he was greatly amused by little problems like this: "there is one nest on the top of a tree and one nest on a lower branch. How many nests do you think can we find on that tree?" He would then make a "nest" with each of his little hands, would place them one above the other, and would find the answer. Of course, his hands then were not counters, not symbols,—they were the nests.

Or I would ask: "you have three marbles, and Bryce has two; who has more?" And the answer would come, after some meditation, in a triumphant little voice, and followed by laughter of satisfaction. Sometimes, later, from the age of three and a half, he would ask us problems similar to those we asked him, and we would take turns in asking and solving problems. Most of the problems dealt with trains, in which he has been immensely interested since babyhood.

At the age of three years five months the following conversation was taken down:

(He was "selling" his blocks, which then represented watermelons.)

"Watermelons for sale; Wootermeelons for sale! Lady, do you want watermelons?"

"Give me three, please."

A. brings me three of his blocks.

"Oh, excuse me, I want four of them, not three."

"Shall I bring one more?"

"Well, I want four of them."

"All right, I'll bring one more."

And he does.

"Count, mamma, do you have four?"

I count, and we both find, that I have four "watermelons."

I call him back.

"May I ask you for five of them?"

"O, then I'll bring another one?"

"I don't know, I want five, that is all."

"All right, here is another one. Let me count them for you—let's see whether you have five."

He counts, and we find, that I have five "watermelons."

"But now I like them so much, I am sorry I asked for five, I want six."

"Six?" A. is perplexed. "You mean five, don't you?"

"No, I mean six."

"Shall I take away one?"

"I don't know. Try and see."

He tries. Counts the rest. "Four! Mamma, do you want four?"

"No, I want six."

He puts the one back again, counts, and finds five.

"Did you ask for five?"

"No, I asked for six."

He tries to put the blocks in different order. Counts—"five!"

Changes order again. Counts—"five!" Piles them up, one on top of the other. Counts them—"five!" Piles them up again, changing order. "Five again!"

"How many do you want, mamma?"

"I want six."

"I'll take away one; no, I'll take away two."

He does, counts the rest: "no, there are three now."

Puts the two back, counts: "Five! Do you want five, mamma?"

"No, I want six."

"O, I'll bring one more. Shall I?"

"Try."

He does, counts, and, triumphantly:

"Mamma, there are six now, I brought one more; count them, mamma."

I do, and we find six.

Then he goes on selling "wootermeelons."

Thus we see, that he was then familiar with numbers within five: he unhesitatingly brought one more block to make up the next highest number. But six was evidently a new num-

ber to him, though he could count (name numbers) to twelve.

When dealing with numbers within five, he knew that adding another block would change the number of blocks; yet it did not occur to him at first to try that, in order to obtain six. Taking away, piling up, arranging and rearranging the order—everything was tried before he thought of adding one.

The piling up and otherwise changing the order of the blocks was not a mere accidental device to make up a number: it was the logical conclusion of a mind whose conception of number is essentially concrete. To A. at that time six blocks meant definite blocks in a definite place, each one being a distinctly individual unit and occupying its own place. If you change the order, you may change the number.

A. had no conception of abstract numbers at that time; counting to twelve did not mean thinking of abstract numbers —or any numbers at all—but merely knowing some definite words in a definite successive order.

When taking away a block to make a smaller number, he would ask which one to take away, and would hesitate long, if the choice rested with him.

He could not at that time count twelve objects, above six he would point to the same block while naming two or three numbers, or would skip his finger quickly over several blocks, while naming only one number. But two weeks later, at three years five and a half months, he could count objects within eleven.

At three years seven months he counted well (named numbers) to 40, and counted objects to 30, after which he would get tired.

A month later he could count to 50—both naming numbers and counting objects.

At that time (three years eight months) he did addition and subtraction within five fairly well without counters, excellently with counters. But his counters were not yet mere instruments for counting. He used then for counters mostly fingers, beads and blocks. If he skipped one, or counted one twice, and his attention was called to the fact, he would invariably inquire—"which one?"—and would not be satisfied, could not understand, unless he knew which one he had skipped or counted twice. Each finger, bead, or block, was still an individual, not a symbol. Sometimes they represented birds, sheep, railroad cars, etc., but then it was: "play like the fingers are birds," and they were birds, but never symbols.

At three and a half he became interested in halves. Every time, when I cut an apple for him, he would watch me closely,

compare the two parts (though he knew that both were for him), and study them. He would ask me to cut his slice of bread and butter into halves: "I want to see the halves." He discussed at length just where was the dividing line of the lower and upper halves of a cup; he would tear a sheet of paper in two and find out whether these were halves; and, very soon after he became interested in halves, he would not be satisfied, when, at his request, I cut a string into halves, if I would make one part a tenth of an inch longer than the other. Exactness was one of his pronounced characteristics since babyhood.

For about three months he was thus intensely interested in halves. Then he began to study quarters in the same way, with the same intense interest, with the same accuracy in measuring.

At three years nine months he used for the first time "first," "second," "third," and also "a pair of horses," "two pairs of horses"—correctly and intelligently.

The period between three years ten months and four years ten months was the period of his enthusiasm for dominoes. His father or I played with him. The game consisted in simply matching, but at first this was a slow process; he used to count the dots each time. Soon however he began to recognize the number of dots at a glance. After some two and a half months the game became too mechanical to be interesting, on account of his spontaneous recognition of the number of dots. We then began to play thus; we had to count dots on both sides of the domino block and match a block which had the same aggregate number of dots. He liked this for a while, and did pretty well, but never grew as enthusiastic over this game as he did over the first. Evidently we made a mistake in introducing it too early. Gradually the dominoes were abandoned.

D. *His Fifth Year*

At the age of four A. went for six weeks (June-July) to the first grade of the observation Summer School at the University of Oklahoma. He liked it very much. In number work he was far ahead of the curriculum, but learned there to recognize the figures 1, 2, 3, 4, 5.

Upon my request he was excluded from writing on account of his age; he tried it however upon his own request, once, but failed: the children began their writing lesson with their first names, and he could not make his pencil obey him to even make an O. He became discouraged, and did not try any more. Yet, he had used the pencil a great deal for

scribbling, since he was about two years old. Pencil and crayons always were and remained his delight.

In August, some six weeks after his fourth birthday, he went on a long trip East, visited several cities, including New York City, rode on trains, sailed on a steamboat across Lake Erie, etc.

The new impressions crowded out his interest in numbers, and yet he applied his knowledge quite often, and even showed mental growth in this direction.

Thus, once, in Brooklyn, N. Y., when looking out of a window at a crowded Sunday street-car, he remarked, that there were almost as many people at that time on that car alone, as live in his home town altogether. Of course, this was a merely quantitative appreciation, not numerical, but it shows good arithmetical judgment.

He also tried to count above fifty, and, when we returned home in September (four years and three and a half months), he counted fairly well to 100. During the next three months he was very much interested in counting successive numbers, and learned to count to 1,000. At four and a half he counted well to 1,000 and had a very correct notion as to "which is more and which is less" within 1,000.

At that time, between the ages of four and four and a half, he especially delighted in counting. He would name the successive numbers one after another till he would be out of breath, then rest a while and go on counting, sometimes asking "where did I stop?" Up to 200, sometimes even farther, he would not be satisfied by counting by tens—he had to name all the numbers, one by one; then, when tired, he would go on counting by tens, and only seldom would he finish by the hundreds alone. Several times he actually counted to 1,000, one by one, with several intervals, during which he would do something else, for a change, and then return to counting, usually with the question "where did I stop?"

I discouraged this counting, not seeing any advantage in it, and fearing the strain. But evidently he obeyed his inner impulse, the need of a muscular and auditory interpretation of his consciousness of number and rhythm. It was a kind of a symbolic activity, and so elemental, that it surprised us, and defied our influence.

When, after 100, he attempted to learn to count more, he asked: "what comes after 100?" I said: "that is enough. Stop at 100, that is all." "Isn't there more? can't I count farther?" he insisted: "tell me, what comes after 100." I

finally said: 101, and, of course, that was enough, he went on to 199.

I thought it strange, that so many times he gave evidence of understanding that there can be no limit to numbers, that you always can add one. Perhaps he simply felt the need to continue the pleasant rhythm, to go on with the fascinating succession of words. Since his auditory memory has always been excellent, he had no trouble in learning to count to twelve; as he grew older, he easily understood the system, on which the names of the numbers from twelve to a thousand are based, and the effort of counting was so small, that it was worthwhile for him to pursue the pleasure ad infinitum.

At the age of four and a half he passed through a severe illness, and was confined to bed for six weeks. During his convalescence his interest in numbers reappeared, but this time in figures only. He began to attempt to trace figures on his blanket with his finger and make us guess what they were. He looked into the paper his father was reading at his bedside, and, finding there figures, studied them, turned the paper around, and showed, that 6 becomes 9, while 8 remains the same. Yet, he did not know the figures well at that time though he had learned them partly on the clock (see below, development of the notion of time).

He was so intensely interested, that I brought him a calendar, consisting of 12 pages,—a page for each month. The dates were printed in black, except Saturdays, Sundays and holidays, which were in brown. The calendar proved a great success. Fearing that A. was straining his eyes ,and also thinking that he was doing too much mental work, I tried to take away the calendar after a while. But A. demanded it again and again. The calendar became the most cherished, the most interesting toy. A. invented a game: he read the numbers in black and made us read the ones in brown, and never grew tired of it, insisting on going over all 12 months at a sitting. Thus he learned to read figures up to 31, and soon, easily, by analogy, to 100.

At that time he did not care much to count without looking at figures, and absolutely refused to do any computation, to even listen to any little problems, in which he used to take such delight before. He was altogether absorbed in the study of the figures.

But, after having mastered the figures, he began to be more interested in computation. He again began to use his fingers in little problems, with the "play like" understanding. But at this stage the "play like" gradually became a mere form, and his fingers mere symbols. For instance, when there were

apples in a problem, he would convert his fingers into apples. He would thus use fingers for any object mentioned in the problem. The ease and swiftness with which his fingers would be converted into different objects, one after another; the expression of his face, and the fact that he soon drifted into the next stage of abstraction, seem to prove, that "play like" was then only a device for solving a problem. The next stage of abstraction consisted in his counting on fingers only one of the numbers to be added: He would wave his hand and say: "I have three apples there; now, here are four more (his fingers); three (over there), four, five, etc. (pointing to his fingers). This was suggested by me, and accepted with such readiness, and even eagerness, that he certainly must have been ripe for it. (At a little over four and a half.)

At about the same time he began to talk about abstract numbers. Thus, he would announce, that two and three make five, or would ask: "how much is six and six?"—usually the doubling attracting his attention. He then liked to solve little problems, using fingers, beads, blocks, etc., as counters.

At the age of four years eight months he began to have every day a half-hour lesson, which, however, by his request, usually prolonged itself to an hour. A few minutes of these lessons were devoted each day to arithmetic. The lessons lasted five weeks (February 18, 1919, to March 25, 1919). He read numbers, counted by two's and by tens, and solved orally little problems within six. Beside number work he had manual training, free hand drawing and drawing of straight lines, and verses were read to him. These lessons were interrupted, because his fourth kindergarten had started.

He liked these lessons very much, and to miss a lesson was a punishment.

At the age of four years nine months A. became greatly interested in typewriting, as a play, without knowing anything about the letters, or concerning himself with them. Several times I volunteered to show him how to typewrite his name. He learned it easily, but without enthusiasm, and did not ask me for any more words, but continued to find delight in striking keys at random and seeing the result. Thereupon I left him alone, and he continued to enjoy the typewriter in his own way. But just before his fifth birthday he began to typewrite figures, sometimes in successive order to ten, sometimes at random, sometimes making up numbers above ten. Seeing his interest in this direction, I prepared for him typewritten columns of little additions within ten, thus:

1+1=
1+2=
1+3=
etc.

2+1=
2+2=
2+3=

He typewrote the answers correctly and neatly, but soon found out, that he did not have to count, but to take successive numbers. Soon after this discovery I prepared for him problems within ten, where the answers were not in successive order:

1+1=	2+3=
1+4=	2+1=
1+2=	2+5=

He completed three columns once, without a single mistake, but did not attempt any more. Evidently, I made this time the same mistake that I had made before with the dominoes: I took the next step too soon.

At the age of five A. began to typewrite the letters, figures, and signs in some arbitrary order, and completed two or three pages of this kind of typewriting, e.g.:

AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
@@@
SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
sssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss
$$

He was then not at all concerned about the meaning of these symbols, and only seldom would he ask about some of them. For most he had his own names, as for instance T he called "the hanging down letter," and E, "the table."

About two weeks after his fifth birthday his interest in typewriting disappeared.

Discussion

There are several striking features in A.'s interest in numbers. The influence of the seasons is one of them. Every spring, for three or four weeks, he would refuse even to consider any suggestion of counting or solving problems. This influence of early spring was regularly repeated in 1917, 1918, and 1919, at the ages of two years nine months, three years nine months, and four years nine months. He would then be entirely taken up with outdoor play, would like to watch the awakening of nature, would dig and romp outdoors all day long. After the three or four weeks he would become interested in arithmetic again, but only at intervals, and not as intensely and wholeheartedly as usual. Throughout the Summer his interest in arithmetic has usually been at a low ebb. At times, suddenly, he would impart to me some of his arithmetical discoveries, even in Summer, but these were rare and short-lived flashes of inspiration. With the approach of Fall they would occur more and more often and would

last longer. In late autumn and throughout the whole winter his interest in arithmetic is always strong and almost continual.

Another marked feature of his interest in numbers is, that it fastened itself on some phase of number work without any external influence. In all his career of a youthful student of arithmetic the choice of the particular subject was his, mostly to my surprise and even disapproval.

Thus, as the above account shows, at the age of three years five months he became intensely interested in counting above twelve, though we discouraged him. His insistence was so great, that in three months he counted well to fifty. Later on, at the age of four years three months, again by his own inquiries and through his own insistence, he learned to count to 100, and then, until four and a half, was fascinated by learning to count to 1,000, which he attained almost without effort.

The above account of his interest in learning figures on the calendar is also illustrative of the same feature: he chose himself the particular step in his study of arithmetic at the given time.

His interest in halves and quarters is another example: it also was spontaneous and all-absorbing.

The third point to note is, that he always uses most of his arithmetical knowledge in work and play, applying it as soon as he gets it. This perhaps is the explanation of the surprising fact, that he hardly ever forgets what he has learned in arithmetic. Thus, after the long intervals in Spring he always emerges with a firmer knowledge of numbers than ever. Yet, at the time, he seems to have forgotten very much, at least does not give satisfactory answers, if put to a test. But as soon as his interest revives,—if even for one hour,—all his previously acquired knowledge reappears unharmed and even fortified. This possibly may be also attributed to the excellence of his memory. I do not know whether his visual or his auditory memory is better, for he excels in both kinds.

II. The Growth of A.'s Conception of Time

At the age of eighteen months A. began to understand short narratives of a few simple sentences, which described little events of his own life within his memory. He was greatly interested in these "stories," but the time element had to be eliminated: the whole "story" had to be told in one tense—we used the past—in order that he should understand it. The first "story" ran something like this: "Oh, a dog was

here; he jumped, jumped, and made: hah, hah, hah, and kissed baby. And baby made: nice, nice!"

Soon however both present and past tenses were used, as the stories grew longer, always truthfully reproducing his own experiences. But up to two years of age he did not understand the future. At two his conception of the past reached as far as three or four days, at least he remembered well events three or four days old. He certainly must have remembered older experiences, but only events three or four days old were vivid enough in his memory to be used with success in our "stories." Two months later stories of events several weeks old invariably obtained a quick and intelligent response.

The first conception of the future I noticed at two, when he began to understand the future tense. It was then that we began to tell him about anticipated events: a walk that was planned for the afternoon, a brook that we were going to see, a hill that we would climb, a goose that we would stop to look at, goats that we would feed, etc. He understood these "stories" very well and looked for the promised things.

At two years nine months he could use all tenses perfectly well himself, thus having mastered by that time the notions of the past, present, and future, the grammatical forms that express them, and the secret of applying these forms to the ideas he wanted to express.

At that age he remembered very well the relation between "yesterday," "to-day," and "to-morrow." Once he remarked: "funny: yesterday was 'to-day,' and now it is again 'to-day!'" This remark he repeated many times, at different intervals, sometimes modifying thus: "Is it again 'to-day?' how funny!" Later on, at three and a half, he began to wonder: "yesterday this, now, was to-morrow; now it is to-day! isn't it funny?" or—"where is yesterday—you know, that was 'to-day' before I went to sleep?"

This wonder at the fleeting time he expressed many, many times, until, at the age of four and a half, he asked: "When will the days stop coming? And where do they come from-Each day goes away—where does it go to? Another one comes—from where? How many days are there over there, where they come from?"

Was he personifying "the days" in any way then? Seemingly he was.

From babyhood A. loved to watch the sunrise and the sunset, and it became a habit with him. He began to associate night with darkness, morning with the sunrise, day with the high sun, and evening with sunset at the age of three, and

had it all worked out in an harmonious system by the time he was three and a half years old. He then became very precise in using "morning," "noon," "afternoon," "evening," "night," associating them both with the meals and with the position of the sun. "Morning" and "afternoon" were divided by the "dinner" (our noon meal), while the division between "morning" and "night" was the sunrise. But, with the advance of Winter, we began to rise before dawn, and he would wonder: "I can't sleep any more. Is it morning? Where is the dawn? Why does not the sun rise?"

The trains were passing by several times a day in full view from our windows. It was his delight to watch them, and every time he would count the cars and make conclusions. He noticed the regularity of the trains and asked every time, "what time is it?" He thus learned, at three years eight months, that the passenger train, north-bound, passes by at "six thirty in the morning" and at "six thirty in the evening," and that other passenger trains, south bound, pass by "at ten in the morning." These hours of the day became therefore distinctly different from other hours and it was in relation to these hours that time was determined, when A. wanted precision. By the time he was four years old, he would say: "supper is late to-night; the 'six thirty' passed about an hour ago, I think." His appreciation of "an hour," was, of course, not in strict accordance with the real length of time; at first it was ridiculously different—either much too long or by far too short. But pretty soon he gave ample proof, that his notion of "an hour" was quite correct.

The regularity of school work helped A. to arrive at this perfection. When, in the Summer of 1918, he went to his little school, he would play on the campus an hour before his school began, and this, I think, contributed toward the precision of the "hour" idea.

At four years four months he was made happy by the gift of a broken alarm clock. The alarm bell could ring, though the clock mechanism did not work any more. He was greatly amused, when he found that he could make it ring, and would play at "waking people" at different hours. He thus learned to tell the hour, and soon learned also the quarter, half and three quarters. When four years ten months old, he told the hour of the day (by the clock) in the following manner:

"It is five minutes after a quarter after three" or "three minutes before half past five," or "one and a half minute after a quarter till seven"—and never made a mistake.

While in the process of learning to tell the time, at four

years five months, he began to show interest in the conception of "a minute."

"How long is a minute?" he would ask. I would take down my clock and show him the minute divisions, then we would both watch the hand move. Sometimes we would try to see, how many minutes we were busy dressing, undressing, combing etc. He was then as intensely interested in his study of the minute, as he has been at three and a half in studying halves and, later, quarters.

He also asked several times—"How many minutes are there in an hour?"—"In a half hour?"—"In a quarter?"—but did not remember the answer.

At the age of four he knew the seasons well and learned the days of the week (with a tendency to omit Thursday, which mistake he makes sometimes even now, at the age of five years two months). At the age of four years seven months—at the period of his enthusiasm for the calendar—he began to learn the months of the year, and showed a clear conception of the seasons. At the age of five he was well acquainted with the twelve months, their chief characteristics, and with the principal holidays. Of course, this progress was helped along by talks, stories, verses, and pictures.

III. The Growth of A.'s Conception of Space

At two years ten months A. first showed an inclination to consciously measure space. He then became interested in the expressions "long" and "short." "Big" and "small" were already in his possession. He asked me then many times: "Is this a long pencil or a short pencil?" I showed him the relativity of sizes and introduced him to the comparative and superlatives. He liked that—liked to put two pencils alongside each other and to compare their lengths; to see which of two books is longer,—in a word, to measure. In this, as in everything else, he was surprisingly precise. Thus he would refuse to acknowledge two books as "just the same," if their length differed by a quarter of an inch.

Step by step, comparing first two similar objects, then different objects (a pencil and a book), he began to measure two objects with a third, used as a unit (a string, a stick, a ruler), trying to see, how many times he could put his unit in the length of the object measured. Measuring became his delight, and from the age of two years ten months to three and a half he was engrossed in this occupation several times a day, sometimes making it the basis of a game. Thus he would play "carpenter" and would measure parts of floors, window sills, garden seats, etc. Or he would make me "tele-

phone" to his "store" and order oilcloth, and he would come and measure my tables to find out how much oilcloth I needed.

This measuring began spontaneously and seemingly without outside influence or example, except that my answers to his questions evidently led him on to the next step. But at three years two and a half months we moved into another house, and the activities incidental to arranging and improving a house gave him much material for imitation and expansion in his measuring activities, and also no doubt served as further stimuli for his interest in this direction. Sometimes he would be contented with superficial imitation—the characteristic "play like" of childhood. But more often he really measured and for the moment was genuinely interested in the results. Of course, I tried to direct his measuring to objects within his easy reach and not beyond his arithmetical knowledge at the given time.

Thus he learned to appreciate space and could tell at sight, at the age of three, which of two objects, differing a few inches, was longer. However, when asked to reproduce from memory the length of some familiar object, he would give ridiculously incongruous answers. Not until he was over four years of age was he able to reproduce sizes from memory by movements of his hands and arms with any degree of accuracy.

At the same time he did not use many adjectives of dimension, and the few in his vocabulary he used indiscriminately, "Big," "wide" and "long" were synonymous, all meaning "large."

At three and a half he used freely and correctly "high" and "low;" while "wide" and "narrow" did not become specialized terms of a linear dimension until the age of four and a half. "Thin," "thick," "fat," "lean," "deep," "shallow" he learned to use correctly during his fifth year.

In spite of the paucity of his vocabulary in the expression of ideas connected with space, he was able to embrace mentally quite wide areas at the age of three. Indeed, his sense or orientation was very good even at the age of two, when he knew the way to his home from all four directions, two or three blocks away in each. At three and a half he knew not only the names of the three stations on the Interurban, but their relative positions with regard to his home town and to the city with which the interurban connected it.

He could tell his address at the age of three and knew the situation of several streets in his home town. At three years two months he would trace in his sandpile the streets adjacent to his own and three or four parallel to it.

At three years seven months he learned to know the names of several States of the Union, some cities in each, and had no trouble in understanding that a State is composed of cities and that many States form our country. At four years four months he gave the following definition: "It is like this: Norman, then the country, then another town, then the country, then again a town—and so on on all sides. This is a State."

At four years I told him the story of Columbus, and he understood perfectly well the spacial interrelation between Europe, the Atlantic Ocean, and America.

A. also showed interest in large spaces and understanding of "near" and "far." Thus, on his trip East, at the age of four years two months, he remarked, after a night's travel on a train: "We are far from Norman now, may be two miles." And some six hours later: "Now we are two and a half miles away from Norman—aren't we?" When we came to New York, he said: "Oh, how far we are from Norman,—may be seven miles!"

His appreciation of sizes of imposing magnitudes showed itself several times, as for instance, when our train stopped in Syracuse, N. Y., he said: "This is a large town, much larger than Norman." And when asked why he thought so, answered: "The buildings are much bigger than in Norman, and I see street-cars full of people, and there are large stores."

In connection with distances the following little dialogue is of some interest (at four years two months, after having been on the roof of a four-story apartment house):

A. The sky is higher here in New York than it is in Norman, isn't it?

His Aunt: Why do you think so?

A. Because there are such high houses here.

His Aunt: Then what of it?

A. Don't you see how high above the roofs the sky is?

His Aunt: Yes?

A. And in Norman the sky is just as far above the little houses as it is above the big houses here.

When he was four years four months old, there was considerable talk in his home about building, and plans of houses were studied. He naturally became interested in plans and began to study them himself and try to draw plans of his own. He learned to make plans very well. Thus, at the age of four years eight and a half months he gave the following proof of it.

I sent him on an errand to a house which he had never seen before, though he knew the people. I told him the name

of the street (he knew by that time all the streets in our part of town) and gave him the house number on a slip of paper. When he came back, he told me that he had found the house by its number, but as nobody was at home, he left the thing I sent by him, in the front room, having slightly opened the door. I said: "Are you sure it was not the wrong house? Tell me how it looks." "All right," said he—"give me a piece of paper and a pencil, and I'll draw the plan for you." He drew such a correct plan of the walks to the house, the porch and the doors on it, that we had no doubts of his having found the house.

Maps have attracted him from the age of four years and four months. I suppose the coloring has much to do with it. The first maps which he examined were those of the U. S. He saw the first one accidentally, asked what it was, and when told, would study it. He easily understood the conventions of the map and the proportions; and had no trouble in appreciating the map of his own State. He likes to trace the rivers, to find cities and especially to study the railroad lines. At five he could easily handle a map, and only his illiteracy prevented him from finding on it anything he pleased. He never mixed up names, never looked for the Atlantic Ocean in Oklahoma, or for Europe in New York City.

Discussion

A.'s interest in time is two-fold: the arithmetical interest asserts itself in measuring time, the broader aspect, philosophical in its character, finds expression in his wonder at the passing away of day.

I have not noticed as strong a seasonal rise and fall in A.'s interest in time, as in his interest in numbers. The mental growth in the direction of appreciation of the time element has been almost evenly distributed throughout the year, and quite a few new steps have been taken in Summer, and even in early Spring. It was in Spring that he learned to distinguish some of the hours of the day by the movement of trains; in Summer he learned to understand the length of an hour; in Fall he began to learn to tell the time by the clock; in late Fall and Winter he was getting acquainted with the minute.

His interest in time, like his interest in number, is spontaneous and his knowledge was obtained by self-instruction.

A.'s interest in space also does not seem to depend upon the seasons.

Some of its phases were less spontaneous than his interest in time and in numbers—they were rather due to imitation. Thus, measuring at one time was decidedly influenced by the

activities of carpenters and other workers in our house; his interest in plans was certainly due to our studying plans at that time, and has passed away since we no longer are busy with plans of houses. But the growth of his appreciation of space and of his sense of orientation is as natural as is the growth of his body; and his interest in maps seems to be wholly his own. Perhaps it grows partly out of his interest for tracing lines and designs. Since the age of four he has liked to follow simple patterns on fences or rugs, traces of wheels on the ground, rails on the railroad, etc., to make "train-tracks" himself, or to draw them with pencil or chalk. There is no doubt however, that since the symbolical meaning of the map was explained to him, it attracted him also as a symbol of the wide world; for he not only traces rivers, railroad lines and boundaries on the map, but also is very much absorbed in studying cities, and countries; and he loves to hear about them.

HOW COLLEGE STUDENTS PREPARE THEIR LESSONS

By Thomas Russell Garth, University of Texas

The purpose of this study is the experimental determination and evaluation of the methods of study of three groups of college students taken as representative of the great body of students in American colleges.

While we have treatments of How To Study and directing the study of students in which the authors (McMurray, Earhart and Swayne) have shown successfully that much of study is of a very inferior sort, the burden of these is to show how the process should proceed and how to direct it, as we have said, and only incidentally do these excellent writers undertake its quantitative determination. The intention here is to make an effort to compel the studying process to take an objective form so that it can be measured.

Method of Securing Data

The method of securing data used here has objectionable features; that is, students are often poor introspectionists and are more or less unsuccessful in putting their introspections into objective form. Other methods for securing data for this problem which we have undertaken to solve, in a measure, may at some time be devised, but for want of those better methods we have used this one with objectionable features.

College students were asked to write "confessions" of how they prepared their lessons and to leave these unsigned. Two hundred such statements were obtained from two colleges, one in the South and one in the West.

The Handling of the Data

In order to bring these "confessions" into such form that they could be evaluated, they were handled by the Order of Merit Method perfected by Cattell, Thorndike and others and especially after the manner used by Hillegas in his well-known work, "A Scale for the Measurement of Quality in English Composition by Young People."

The samples were first sorted out in five piles running from poorest to best by four judges including the writer. From these five piles five samples were selected from each pile

making twenty-five samples. These twenty-five samples were then judged by one hundred competent judges from universities, colleges, and normal schools fairly well distributed over the United States. The judges were persons directly engaged in the study of educational process; some are people of note and many are persons who, while gifted with pedagogical discernment, are not very prominent excepting in their immediate neighborhoods.

The business of securing judgments was a matter of considerable time—four years, and the small number of judgments, one hundred, is in part due to the fact that many who were asked to participate were unable to find the time to arrange the samples. Some were sceptical about the advisability of treating the data in this fashion. The cooperation of those who did participate is deserving of much commendation for it was no small thing, either in respect to time or energy, to arrange the samples (these were at first mimeographed and later printed on tag-board cards) in order of merit, placing the poorest method at the bottom and the rest above it, according to the judge's best judgment, until the best method would be found to be on top. Records were made of these orders, and a tabulation of these was obtained so as to bring all the judgments into relation.

By following closely the method used by Hillegas in deriving his scale, a scale for methods of study was derived from these data. The scale values and the samples are found in Table I. It will be seen on examination of this that only nine of the twenty-five samples are used in the scale. Because of the fact that the others were either equal or very nearly equal to some one of these nine, they were discarded as having little value for the purposes in hand.

TABLE I

Sample	Difference From Preceding	Difference From Sample 225
225		00
370	7	7
230	19	26
277	130	156
272	86	242
279	78	320
316	78	398
310	86	484
375	41	525

After the scale had been derived, new "confessions" were added to the one hundred and seventy-five original samples which had not been judged by the hundred judges, and these were rated according to the scale. These results will be given below.

The Scale for Measurement of Methods of Study of College Students

The samples selected for the scale and their values are given herewith. No effort was made to obtain experimentally a zero point in method of study. Sample No. 225 is decidedly the lowest one in the scale according to the opinion of the judges. It cannot truly be called a zero value, but we have arbitrarily taken it as a zero value "over and above what any common sense person might do in the way of study."[1]

Value 0—Sample 225

"I read the lesson over carefully from about 3 o'clock to 4:40."

Value 7—Sample 370

French II. "I first seek to get everything prepared for studying, such as poking the fire, putting cushions in my chair, and resting my feet on the table. After I have made due preparations for such a heart-rending task, I open my books and find that I don't know where the lesson starts, so as I wish to see if I received any mail, I go over to the post-office and stand around talking awhile. Finally I sum up courage enough to approach some member of French II class and ask him where the lesson starts. As I notice a blank look coming over his face, I become aware of the fact that I must seek another man, so approaching the star member of the class, I ask him for the information. He tells me without even consulting his note book. Then I wend my way homeward for the purpose of studying.

I give the fire one more vicious poking and then seat myself and get in good position to start looking up words and reading French. Those words which are important I generally have to look up twice before I am able to remember them. I try to bear in mind the general run or rather plot of the story and this aids me in remembering words, but before I look up any word in the vocabulary, I give a guess at the meaning and then look it up to find out whether my guess

[1] The writer is under obligation to Professor E. L. Thorndike for this suggestion.

has been correct. After working at this until my fingers become sore from turning back to the vocabulary and my mind becomes sluggish and lazy, I carefully, though thankfully, lay my book on the table and try my luck on a new study, with the resolute decision of finishing my French II early in the morning while every one is asleep. Next morning I wake just in time to jerk on my clothes and walk very hastily to breakfast."

Value 26—Sample 230

"I study my lesson in advance and then take notes in class. Sometimes I will not open a book for a week. Two of my classes are purely lecture work so I just take notes."

Value 156—Sample 277

"I do my studying in the afternoon or evening. The manner in which I do my work is according to the subject. If many points are mentioned, I take notes, but if not I take no notes and then when I go to class I make notes of principal points."

Value 242—Sample 272

"In lessons such as Math. and Chem. I work all the problems until they are as nearly correct as I can make them, and I learn every important point in the lesson, but in Psychology and History, etc., I generally merely read the lesson although sometimes I make an outline of the main points."

Value 320—Sample 279

"In studies that are reading material such as History and Psychology I read over and underline important parts, then review underlined passages. In Math., which I am making my chief study, I try to solve the problems; then if I do not succeed I then try to read the instructions. Very seldom study after dark, because I think many students ruin their eyes by studying by electric light."

Value 398—Sample 316

"I always study first those subjects which I dislike most. In Math. always study the principles first and then apply them to my problems. In other subjects I use an underlining method, by which I underline all principal ideas and facts. This is a great aid when it comes to reviewing, especially at examination time. Comfort has a great deal to do with my studying. I have to have a light a certain way, my chair, etc., all suitably arranged. The time of day is also

of importance. Such a time as hour from 5 to 6 is utterly lost."

Value 484—Sample 310

"Reading subjects as History, Psychology, etc. (1) Thorough reading, (2) Brief notes on important points, (3) Notes allowed to cool, (4) Notes looked over, and contents called up.

Written subjects: as English work, etc. (1) Rough draft drawn up, (2) Final copy written, with corrections and alterations.

Scientific subjects: such as Chemistry, Physics, etc. (1) Read carefully, (2) Thorough notes taken; (3) Notes allowed to cool; (4) After which only notes studied, very handy for examinations.

Mathematics: I try to work the assignment.

In all my studying, whenever interest is lost, before the assignment is completed, I set aside that work, taking it up at a future time, and try to study some widely different subject."

Value 525—Sample 375

"Before entering into an analytical discussion of this topic, I might preface the fact that I cannot study anything that requires concentration while any kind of noise is going on, unless perhaps one to which I have become acquainted, and accordingly I endeavor to study in quietness.

On considering the subject from a more specific standpoint, I find that in general my natural tendency is to crystallize, materialize, or cast into a more tangible form, whatever I am studying, if it be not already in that form. This manifests itself in probably four different phases or methods: First, when the subject-matter is largely memory work, as in certain of the sciences (e.g. biology) grammar and syntax, unclassified theory, etc., I generally fix it in my mind by writing notes and synopses and so reducing it to a more concrete form: Second, whenever possible as in the sciences, I find the drawing of diagram of great value: Third, the application of rules and theories as in Math., to practical problems, engages my attention even before the rules and theories themselves are understood: Fourth, in languages such as French and German, the giving of concrete examples appeals to me much more than the formal statement of the rules and laws, which I not infrequently neglect in favor of the former. In general I may say that on such subjects as English which are more or less exegetical and philosophical by nature, my tendency is (I believe) to generalize, view the

subject telescopically so to speak, and make considerable use of the principle of Association. On such subjects as Mathematics and Sciences on the other hand, where for the most part reasoning is close, concise, and exact, I follow what might be called the intensive method, i.e., concentration entirely on that portion of the subjects under discussion without thought or reference to what has gone before. In every kind of study, however, I find that the principle of association comes into operation to a greater or less extent, as my mind is constantly connecting various other facts and ideas as I come across them in preparing a lesson with other facts and ideas that I have learned or even only met with in previous reading and studying.

Another general assertion I might make from another point of view is that my first reading over of the lesson affords me a more general insight into the subject as well as the acquisition of the more important and outstanding features, while the second perusal familiarizes me to a greater degree with the details."

Variability Among the Judgments

While it is not intended to undermine the integrity of the experiment by criticising the reports of the judges, it would be interesting to ascertain to what extent there was agreement between the several persons who judged the material. This is no criticism of the judges. On the other hand, the scale is the result of the pooling of their judgments. For that matter the scale must not be regarded as a "criterion" for all study.

Hillegas penalized his judges for the purpose of showing the reliability of the judgments. We penalize them here to show what a vast difference of opinion is to be found among competent educators on the score of proper method of study.

Table II is a tabulation showing what penalties were given for placing a sample below where it belongs on the scale as derived. Table III gives the distribution of penalties assigned to the several judges. Among the four whose penalty is 0, i.e., whose arrangement of the sample methods of study was practically identical to that of the arrangement of the scale, is a supervisor in one of the southern Normal Schools, one is an instructor in a northern Normal School, one is a graduate student in one of our foremost Teachers Colleges, and another is a university professor very prominent in educational research.

An examination of Table III shows that some of the judges had opinions very divergent from the common opinion repre-

sented by the scale. One judge, the author of a series of elementary textbooks, placed the samples in almost reverse order from that of the scale. In fact the Median of the penalties is far up the scale and the range runs from 0 to 269. The measures of variability are high. These facts would

TABLE II[2]

PENALTIES FOR PLACING A SAMPLE OF LESS VALUE ABOVE ONE OF GREATER VALUE.—(When 375 is placed below 310 the penalty is 2; below 316, it is 4; below 279, it is 6; etc.)

S	S	P		P		P		P		P		P		P		P
375	310	2	316	4	279	6	272	6	277	8	230	10	370	5	225	12
310	316	4	279	8	272	10	277	12	230	12	370	12	225	14		
316	279	4	272	7	277	9	230	10	370	10	225	14				
279	272	4	277	7	230	10	370	9	225	12						
272	277	4	230	9	370	7	225	14								
277	230	6	370	4	225	6										
230	370	1	225	3												
370	225	0														
225																

justify the conclusion that while there is sufficient unanimity among the judges to derive a scale more or less satisfactory, many of the judges do not agree altogether with the results.

How College Students Prepare Their Lessons

After having derived a scale for determining quantitatively how college students study, samples were taken and rated by the scale. The material thus measured was the remaining one hundred and seventy-five samples left after the twenty-five which were judged by the hundred competent judges had been taken out. We shall call this Group A. It is composed really of two groups, as the students who wrote them are from the two colleges, in the South and West. Group B is composed of fifty-seven normal college students. The writer rated these specimens, being the only judge employed here. The samples of Group A were rated by him three times, of Group B twice, and these ratings were averaged. The results were distributed as below:

[2] The above table is gotten by ascertaining the differences (M.D.) between each sample and any other sample which does not rightly belong above it and a more or less arbitrary value is given that difference. For instance the difference between 375 and 310 is 34 and the penalty for placing 310 above 375 is 2; the difference between 375 and 316 is 74 and the penalty is 4.

See Hillegas, "A Scale for the Measurement of Quality in English Composition by Young People," pp. 58-60.

Scale Value	Group A Frequency	Group B Frequency	Total Frequency
0– 99	18	6	24
100–199	15	3	18
200–299	64	18	82
300–399	49	14	63
400–499	10	9	19
500–599	2	7	9
	158	57	215
Ave.	264.2	315.6	287.7
A.D.	83.1	115.8	84.6
P.E.	70.2	97.9	71.5

Table III.—Distribution of Penalties given to judges for wrong order.

Penalty	Frequency	Penalty	Frequency	Penalty	Frequency
00	4	38	2	76	
1	0	39	0	77	
2	1	40	1	78	
3	1	41	0	79	
4	9	42	1	80	
5	4	43	3	81	1
6	3	44	0	82	1
7	2	45	2	83	
8	3	46	0	84	
9	1	47	0	85	
10	0	48	0	86	
11	4	49	1	87	
12	3	50	1		
13	3	51	0		
14	4	52	0		
15	3	53	1		
16	2	54	1	99	1
17	1	55	1	100	1
18	1	56		223	1
19	3	57		236	1
20	4	58		269	1
21	1	59			
22	0	60		Total	100
23	1	61	2		
24	1	62	0	Median	19.5
25	1	63		P. E.	13.5
26	4	64		Q.	15.8
27	0	65		A. D.	23.69
28	0	66			
29	1	67	1		
30	0	68			
31	0	69			
32	2	70			
33	2	71	2		
34	2	72	1		
35	1	73			
36	0	74			
37	1	75			

(In Group A there were 17 statements giving no method and as these were thrown out, only 158 were left to be measured.)

The average rating for Group B is slightly better than that of Group A though it is, according to the judges, just a little better than mediocre study or something better than half-way up the scale. The average for the Group A approximates a point half-way between 0 value and 525, the value of the best sample. The two groups, as indicated by the average of the two taken as one, are slightly better than this half-way point. By referring to the scale one can see that this half-way point lies between Samples 272 and 279 whose values are respectively 242 and 320, but more nearly to the former than the latter. Here the student claims that he learns every important point in the lesson in some subjects, but merely reads some lessons in other subjects, sometimes making an outline of the main points. Of the total group of 215 only 9 receive a rating of the highest point on the scale, i.e., 525 and 24 lie between the arbitrary zero and 99.

If to study in the true sense of the word is to think, and the present writer might be allowed to suggest where purposive thinking undoubtedly occurs on the scale, it would appear that of these 215 students only nine of them really study according to their confessions. That is 4% of them are pursuing their studies in true problematic fashion. If this be true, what can be said of the remaining 96%? It would appear that they are engaged in some form of memoriter work.

AUTOMATISMS IN STUDY

By E. Leigh Mudge, Washburn College

An absolutely quiet school room is the ideal of an unscientific pedagogy. Even adults make many more bodily movements during an hour of study than they realize. A very little observation or a very simple experiment will demonstrate this. Few of us realize how much activity there is, for example, in our toes. An attempt to sit for five minutes without a movement of a toe will illustrate how active these usually unobserved members tend to be. In deep study most, perhaps all, of us engage in certain apparently irrelevant movements, such as tapping the floor with the foot, tensing various muscles, frowning, pursing the lips, etc. Professor Lindley has found as many as 136 distinct automatisms which are involved in close attention and study. And let anyone observe the movements of a classroom of studying children, free from the usual inhibitions of adult life, and it will be evident that there is reason for some of the sounds and movements of the desired-to-be quiet school.

A class of seventeen young women in college recently listed the automatisms which they recalled having frequently used, together with the physical conditions of successful hard studying. Of these, fifteen mentioned some sort of manipulation of the hair, running their fingers through it, twisting a lock, fastening it more tightly with a comb, putting in hairpins and taking them out, or pushing the hair back from about the ears and neck. Thirteen spoke of various other movements of the hands about the face and head: rubbing the temples or forehead, supporting the forehead or the chin upon the hand, rubbing the ear with the hand, etc. One spoke of the tendency, when a statement is difficult to grasp, to tap the forehead and repeat the sentence rythmically. Fourteen mention the positions or movements of the feet. Of these, five must have the feet off the floor in order to study well, three must sit on one foot, and others mention crossing the feet, tapping the floor, sitting with the tips of the toes resting on the floor, and wiggling the toes. Eight students mention a tenseness of muscles, frowning, and the strain of which one is not aware until at the end of the period of intense study when there is a sigh and a relieved stretching of muscles. Eleven persons mention the use of a pen or pencil, aside from actual writing involved in the work, in tapping on the table, tapping upon the teeth or else being firmly held between the teeth, making letters or figures of various kinds, or tracing a line upon paper until the paper is worn through. One runs the pencil through the hair, and one recalls the childhood habit of "writing with the tongue." Other automatisms mentioned are: rocking back and forth, walking, frequently shifting position, talking aloud, and humming a tune. Several mentioned the need of a not too comfortable chair and of loose, comfortable clothing. One student, "when ready to make interpretation or association necessary to fix the point," lets her eyes wander, perhaps looking out of the window at some tree or other object.

At first thought, all these movements seem irrelevant to the work of the student. The universality of some such automatisms, however,

seems to indicate that they have some practical value. Certain muscle strains appear to be characteristically involved in a state of attention. We can best attend when there is a degree of muscle-strain. And the function of the often slight auxiliary movements is probably in their drawing off of certain surplus values of nervous energy so as to prevent their discharge in irrelevant and diverting thoughts or actions which would disturb the central thought process. Professor Karl R. Stolz, in a study of "Auto-Suggestion in Private Prayer," has shown that the use of the rosary by Roman Catholics, Buddhists, and others, involves this principle. The slight movements in manipulating the beads and the habitual repetition of monotonous phrases provide "an outlet for distracting impressions." If this is true, and if the various bodily movements of one who is in serious study actually contribute to the success of his work, it is clear that a certain degree of freedom of movement is absolutely essential to the mental as well as the physical welfare of school children.

BOOK NOTES

The Historical Child. By OSCAR CHRISMAN. Bost., Richard G. Badger, 1920. 471 p.

Dr. Chrisman is one of the pioneers in the study of children in this country, and we owe to him the term "paidology" to designate this field. He has in this book brought together very interesting and new material, which only Ploss had ever attempted to compile in any other language. The chapters are devoted to the child in different countries, e.g., Mexico, Peru, Egypt, India, China, Japan, Persia, Judea, Greece, Rome, in medieval Europe, and finally in the United States. This book certainly fills a long-felt need among English students of the subject, and everyone interested in children should be acquainted with it.

Education During Adolescence. By RANSOM A. MACKIE. N. Y., E. P. Dutton and Co., 1920. 222 p.

This book, the author says, is based partly on G. Stanley Hall's "Psychology of Adolescence." After a general chapter on education during adolescence, he divides his material into successive chapters as follows: Six-Year High School Curricula; Principle of Election in Education; Changes Proposed in Secondary Education; Required Subjects: The Social Studies, English, and History. The author has put into this work studies of many years, and he has brought together in a more systematic way the various articles he has printed elsewhere. At the end there is an excellent bibliography of over two hundred titles.

Modern Elementary School Practice. By GEORGE E. FREELAND. N. Y., The MacMillan Co., 1919. 408 p.

The author has here brought together the results of many practical and theoretical studies in an interesting way and with a somewhat novel purpose. The scope of the book can best be indicated by its table of contents, which is as follows: The Application of Educational Theory, The Problem Method, The Project, Motives, The Doctrine of Interest in Practice, A School Subject Taught Through Interests, Utilizing a Common Interest, The Development of a Natural Interest, The Selection and Emphasis of Subject Matter, Selection and Evaluation in English, Selection in Arithmetic, Spelling, and Writing; Methods Which Foster Health, Less Sedentary Practices and Methods, The Individual-Social Balance, Methods of Adjusting School Work to Individual Needs, The Socialization of Instruction.

Human Psychology. By HOWARD C. WARREN. Bost., Houghton-Mifflin Co., 1919 460 p.

The author has for many years been one of our leading teachers of psychology and here brings together the results of his experience. While his own psychological proclivities are evident, he is not blind to other aspects of psychology and has given us here a comprehensive study which is admirably adapted as an introduction to the topic. The chapter headings are as follows: The Science of Psychology, The Organism, The Neuro-Terminal Mechanism, Physiology of the Neuron, Stimulation, Adjustment, and Response, Behavior, Conscious Experience, The Senses, The Components of Mental States, Primary Mental States, Secondary Mental States, Succession of Mental States, Atti-

tudes, Character and Personality, Organized Mental Life, with an Appendix containing chapters on The Mind-Body Relation, Mechanism and Purpose, Neural Activity, and The Visual Process.

Man and the New Democracy. By WILLIAM A. MCKEEVER. N. Y., Doran, 1919. 250 p.

In view of the greatest tragedy in history—"Ten million slain; one hundred million homeless; countless millions sad"—the author proposes a radically new interpretation of the world war and a plan for the reconstruction of civilization which will practically reverse the old order of things. The momentous heap of wreckage is symbolic of the contempt of the Almighty for the so-called achievements of modern civilization. It is a little difficult to state briefly or even find out precisely the author's revolutionary principle, but it is apparently to go back not merely to human nature but to child nature and to build up better generations—"A little child shall lead them." A new system of education could make democracy creative, teach it that work is a means of salvation, give a new interpretation to motherhood, adolescence, religion, health, loyalty and altruism. The problem is whether we are ready for democracy, which means reorganization from within, making life more worth while, increasing the spirit of sacrifice, teaching optimism, realizing the dangers of obsession, and thus warring on white slavery. The fact is psychology is the basis of human betterment, and the next generation must improve on the past and the present. Thus new demands are made upon psychology.

An Ethical System Based on the Laws of Nature. By M. DESHUMBERT. (Tr. from the French by L. GILES). Lond., The Open Court Publ. Co., 1917. 231 p.

This work, we are told, has already appeared in seven languages. In a Preface by Dr. C. W. Saleeby it is said that it "is a real contribution to the didactic literature as yet so scanty and inchoate, of the Religion of Life." Ethics, in a sense, long anticipated evolution, and just now we are making history so fast that we are in danger of forgetting the past. But Spencer, Darwin, Bergson and Ellen Key have made contributions to the practice of the Religion of Life founded on evolution which can never die.

The author undoubtedly has been influenced by Confucius and perhaps by the doctrine of return to Nature, and his chief interest is to know what the real aim and tendency of Nature as manifested in her works is. He has set forth his general theory in a very comprehensive and somewhat philosophical way and in Part II he contributes a complement to the theory in the form of answers to objections, while Part III is devoted to duties and precepts, and the final chapters are on Death.

My Country. By GRACE A. TURKINGTON. Boston, Ginn and Co., 1918. 394 p.

This is a textbook in civics and patriotism for young Americans. It is written to meet present needs and not those of five years ago. America and her people, her relations to liberty, the making of Americans, the children's age, why we have schools, how things come about, representative government, paying the people's bills, an enemy of the United States, efficiency, war, the army and navy, our flag, etc., are the most salient of its twenty-three chapters. The work is illustrated by many cuts.

Applied Arithmetic. By N. J. LENNES and FRANCES JENKINS. Phil., J. B. Lippincott Co., 1919. 283 p.

This is the first of a three-book series, and is intended to end with the fourth grade. Special attention is paid to the selection and organization of subject matter, derivation and application, and motivation. There are many cuts calculated to make the problems objective and concrete.

General Methods of Teaching in Elementary Schools. By SAMUEL CHESTER PARKER. Boston, Ginn and Co., 1919. 332 p.

This work is intended for normal and training schools and for teachers' reading circles, and is the outcome of fifteen years' experience. It covers the kindergarten and first six grades. Part I is devoted to Fundamental Points of View, with five chapters; and Part II to Learning Processes: General Aspects.

The Gary Public Schools: Measurement of Classroom Products. By STUART A. COURTIS. N. Y., General Education Board, 1919. 532 p.

Here we have an attempt at a survey of the Gary public schools tested by classroom products. After a general statement of the tests given and the conditions, there are separate reports on handwriting, spelling, arithmetic, composition, reading, with subsequent chapters on factors affecting performance and finally general conclusions.

Americanization. By ELI MAYER (with an introduction by Dr. JOHN H. FINLEY). Publ. by The Sophereem Co., Albany, 1920.

Educational Sociology. By W. E. CHANCELLOR. N. Y., The Century Co., 1919. 422 p.

The purpose of this book is to serve as a general introduction to sociology with especial reference to education, which fits for society. It is divided into three parts: I, Social Movements, with seventeen chapters including The Nature of Human Society, Public Opinion; II, Social Institutions such as The State, Property, The Family, The Church, School, Art, Science, Business, War; III, which is perhaps the most interesting, is entitled Social Measurement, with chapters on The Social Survey of the Community, Institutional Workers, and The Socialized Mind.

Scientific Handwriting. By CHARLES T. LUTHY. Peoria, 1918 (Publ. by the author). 233 p.

This is an interesting and comprehensive work divided into two parts, the first on Execution with sub-heads on many topics, such as The Desk, Paper, Pen, the Fingers and their movements, size and form of characters, the arm, finger, and wrist action, and the method to be followed in school, which the author says must be logically correct. Part II is entitled The Basic Parts of the Letters, and this deals with loops, ovals, etc. The work is very copiously illustrated.

Armenia and the Armenians. By KEVORK ASLAN. (Tr. from the French by PIERRE CRABITÈS). N. Y., The MacMillan Co., 1920. 138 p.

This is, to a great extent, an epitome of the author's larger volume published in 1908 entitled *Etudes Historiques sur le Peuple Arménien.* His former work extended only through the eleventh century, but a later edition brought the history of Armenia up to date. In the suc-

cessive chapters the author treats of the geographical configuration of Armenia and the origin of the people, the formation of their royalty and its various dynasties, the conversion of the country to Christianity, Armenia under the domination of the Byzantine Empire, the Seljuk invasion, and finally the Armenians during the nineteenth and early twentieth century.

Manual for Conservation of Vision Classes. By WINIFRED HATHAWAY. Publ. by Nat. Com. for Prevention of Blindness (N. Y.), 1919. 108 p.

The author treats of the history of sight-saving classes in America, gives us reasons for establishing classes for the conservation of vision, takes up the subject of equipment (many illustrations), medical school inspection, systems under which conservation of vision works, discusses Cincinnati's cooperative plan and cooperation generally between the grade and the special teacher, vocational guidance, criticizes existing conditions, and outlines future possibilities.

An Introduction to School Music Teaching. By K. W. GEHRKENS. Boston, C. C. Birchard and Co., 1919. 132 p.

This book seeks only to give general information concerning matters pertaining to music teaching in public schools from the point of view of the supervisor and the school superintendent. Accordingly the author treats such topics as the modern educational trend, the value of music as a school subject, appreciation as an end in music, the work in music of the first three grades, of the intermediate and upper grades, the importance of ear-training, instrumental music in the grades, high-school music, the chorus, theory class, and finally he describes the work of the supervisor and grade teacher, with an appendix on the former's library.

The Project Method in Education. By MENDEL E. BRANOM. Bost., Richard G. Badger, 1919. 282 p.

Modern education attempts to direct the child's development so that he will be a worthy participant of the institutional life of society, and also to develop the particular abilities of each for the sake of individual initiative. Rapid evolutionary changes in society have emphasized the need of reëvaluating and of reorganizing subject matter, the author tells us in his Preface. Accordingly he here gives us fourteen chapters devoted to such subjects as the evolution of the project as an educational concept, its relation to instincts, teaching and learning by projects, the project-question, -exercise, and -problem, manual or physical projects, the method in History, Geography, with final chapters on the reorganization of the course of study and the preparation of the teacher.

War Addresses of Woodrow Wilson. Ed. by A. R. LEONARD. Boston, Ginn, 1918. 143 p.

There are three reasons, we are told, why the study of President Wilson's war addresses may wisely be included in the course of study in every secondary school. The first is their intrinsic literary merit; the second, their timeliness; and the third, the connections with the war. We are also told that the President authorized the printing of these addresses in the present form, of which there are fifteen in all. The value of such a publication is obvious.